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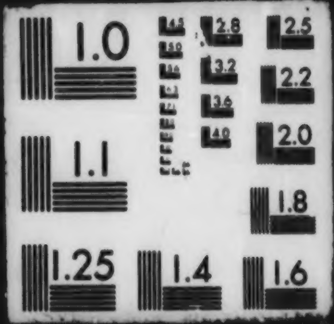
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U.S. DEPARTMENT OF COMMERCE
National Technical Information Service

PB-257 693

WASTE OIL STUDY. REPORT TO THE CONGRESS

ENVIRONMENTAL PROTECTION AGENCY

APRIL 1974

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REPORT TO THE CONGRESS

WASTE OIL STUDY

Authorized by
Section 104(m), Public Law 92-500

April, 1974

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This report presents the results of studies undertaken to determine the extent of the problem resulting from the disposal of waste oils and the effect of various disposal techniques on the environment. The report is submitted in fulfillment of Section 104 (m) (2) of the Water Pollution Control Act Amendments of 1972. Waste lubricating oils contain a myriad of contaminants depending upon their usage. In general, they contain oxidation products, sediment, water and metallic particles resulting from machinery wear. The collection of waste oils from industrial operations and automotive service facilities is the weakest link in the overall waste oil recycling/disposal scheme. Disposal methods currently used include refining, use as a fuel for industrial and utility applications, use in road oils, asphalts and as a dust palliative, disposal in sanitary landfills, and surreptitious dumping on land or in water. The re-refining industry in the United States is discussed. Results of the biological studies to date are presented.

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*Lubricants,

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Oil pollution,
Reclamation,
Refining,
Fuel oil,
Water pollution control,
Environmental impacts,
Government policies,
Regulations,
Physical properties,
Trace elements,
Economic analysis,
Legislation,
Contaminants,
Sanitary landfills.

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Water pollution effects (animals).

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"WASTE OIL STUDY"

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Environmental Protection Agency
Washington, D.C. 20460

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PREFACE

This report is submitted to Congress in compliance with Section 104(m) of the Federal Water Pollution Control Act Amendments of 1972, Public Law 92-500.

The report was prepared under the supervision of Mr. Kurt Jakobson, Chief, Agriculture and Spills Branch. Major inputs were provided by Dr. John Jaksch, Washington Environmental Research Center, Dr. Peter B. Lederman, Director, Industrial Waste Treatment Laboratory, and Dr. Thomas J. Padden, Agriculture and Spills Branch, Office of Research and Development.

Appendices B, E, F, and G were prepared by the Environmental Law Institute, Washington, D. C. under contract to the Environmental Protection Agency. These appendices do not necessarily reflect views and policies of the Environmental Protection Agency.

SUMMARY

This report presents the results of studies undertaken to determine the extent of the problem resulting from the disposal of waste oils and the effect of various disposal techniques on the environment. The report is submitted in fulfillment of Section 104 (m) (2) of the Water Pollution Control Act Amendments of 1972.

In 1972 approximately 2.2 billion gallons of lubricating oil were sold in the United States. Approximately 50% of this lube oil was consumed in use, discarded with filter cartridges, lost through leakage or in other ways resulting in the generation of an estimated 1.1 billion gallons of waste lubricating oils for which environmentally acceptable disposal was required. Approximately 600 million gallons of waste automotive crankcase oil and 400 million gallons of aviation and industrial lube oil made up the majority of the waste oils generated.

The demand for automotive lubricating oil has been leveling off since 1965 because of increased intervals between oil changes. The total demand for lubricating oils has increased at an average rate of 1.3% annually in the period from 1965 through 1972. This increase was due to the increased demand for industrial lubricants.

Waste lubricating oils contain a myriad of contaminants depending upon their usage. In general, they contain oxidation products, sediment, water and metallic particles resulting from machinery wear. In addition to these, waste automotive lubricants also contain organic and inorganic chemicals used in oil additives and metals which were present in gasoline and transferred to the crankcase during combustion (blow-by). Lead is the principal metallic contaminant found in waste automotive oils, being present in amounts which sometimes exceed 1% by weight. It is expected that this lead concentration will decline as the use of non-leaded gasoline is increased.

The collection of waste oils from industrial operations and automotive service facilities is the weakest link in the overall waste oil recycling/disposal scheme. It is estimated that there are between 1000 and 2000 waste oil collectors in the United States, most of whom are poorly equipped and operate in urban areas only. In rural areas the small quantities of waste oil generated per square mile cannot economically support waste oil collection systems. Disposal methods currently utilized include re-refining, use as a fuel for industrial and utility applications, use in road oils, asphalts and as a dust palliative, disposal in sanitary landfills, and surreptitious dumping on land or in water.

depressed

The re-refining industry in the United States is ~~a small~~ industry generally using old process technology and, in most cases, is very susceptible to economic fluctuations. Depending on local conditions, some re-refiners are experiencing difficulties in obtaining feedstocks

[illegible]

for their operation due to the competition for this material from other users. The most commonly used re-refining process, acid/clay treatment, does not appear to be an attractive approach for expanding the re-refining industry because of its high operating costs and because of the difficulty in disposal of the residual waste products. Several other re-refining processes are technologically and economically more attractive. Of these, the distillation/hydrogen treating process is considered the most promising waste oil re-refining process assuming that the distillation bottoms can be economically utilized to recover the lead which will be present. The process will also be the most environmentally acceptable.

At the present time, it is estimated that 40% of the waste oil collected is utilized as a fuel. It should be noted that if all the waste oil generated annually were available for use as a fuel, this would represent less than 1 percent of the total annual coal and petroleum energy consumed in the United States.

The combustion of waste crankcase oil without removal of contaminants, can cause adverse environmental effects. From the public health point of view, lead is the most significant contaminant. The amount of lead that can be introduced into the atmosphere from this source is estimated to range from 2 to 5 percent of that discharged through automotive exhausts, the present major source of atmospheric lead. This environmental impact can be minimized by employing existing technology to remove the contaminants prior to combustion or by the use of high efficiency air pollution control equipment to remove the contaminants in the stack gas before they enter the atmosphere. These restrictions will increase the cost of utilizing waste oil as a fuel and its economic desirability will be governed by fuel prices in any given location at any given time.

Results of the biological studies to date indicate a difference in toxicity among species, among methods of introducing the oil, and between marine and freshwater organisms. However, many problems require further investigation to determine sublethal effects and aquatic community structure changes due to waste oil.

Acid sludge and spent clay generated during re-refining can be safely disposed of in landfills if proper handling and disposal practices are followed. Soils have been shown to provide a high degree of physical, chemical and biological treatment for organic wastes. Oily waste disposal by land spreading has not been generally appreciated or exploited.

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SECTION I

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

1. Total waste oil generation is estimated to be about 1.1 billion gallons annually in the United States. The major sources of waste oil are automotive operations which produce about 600 million gallons, and industrial and aviation operations which produce about 400 million gallons; other sources, such as U.S. government purchases and industrial process oils, account for the remaining 100 million gallons.

2. Presently, the best estimate of the ultimate fate of this 1.1 billion gallons of waste oil is: 480 million gallons treated or untreated, used as fuel; 90 million gallons re-refined to lube oil; 200 million gallons used in road oil and asphalt; and the fate of 340 million gallons, including 30 million gallons of re-refinery wastes, is unknown. Better estimates of the ultimate fate of waste oil are not possible because of the lack of accountability across the splintered collection, re-refining and disposal systems.

3. There are no technical impediments to physically recycling waste lubricating oil. The processes applicable in petroleum refining are generally adequate, with modification, for processing waste oil; however, as a matter of practice virgin crude refineries do not recycle waste oil because metallic contaminants present in the waste oil can adversely effect some key catalytic refining processes.

4. At the present time, the re-refining industry appears viable and a Federal subsidy is not required; however, vagaries of the existing energy situation could hinder or aid its continued profitability. Re-refining of waste oil is complicated by: the difficulty of securing sufficient feedstock to operate existing plants at rated capacity; labeling requirements which connotate that products made from waste oil are inferior; increasingly more stringent environmental controls that require expenditures for capital improvements; increasing difficulty in disposing of acid/clay sludge waste resulting from the process that predominates in the industry; the lack of quality assurance that would generate confidence in the products of re-refineries.

5. Waste crankcase oil may be used as fuel if highly efficient particulate control systems are employed to reduce preventable lead exposure. The combustion of waste crankcase oil is also permissible if a high-level pretreatment is utilized to reduce the lead concentration in the oil to a level which does not exceed the background lead concentration or where resulting emissions are unlikely to result in increased human exposure.

6. Indiscriminate disposal of waste oil is potentially detrimental to the environment. A concentration of 1 mg/l of oil in surface or ground waters causes taste and odor problems in drinking water. Concentrations of 50 to 100 mg/l can impede waste treatment processes. Results of biological studies to date indicate a difference in toxicity among species, among methods of introducing the oil, and between marine and freshwater organisms. Significant chronic effects were found at concentrations of 310 ul oil/liter of water and higher on the freshwater species tested. Acute toxicity levels varied from 370 to 11,000 ul oil/liter of water depending on the oil phase to which the freshwater fish were exposed. A concentration of 1.0 ul oil/liter of water was found to be toxic to certain marine forms. Many problems require further investigation to determine differences in response among species, sublethal effects and aquatic community structure changes due to waste oil.

7. Preliminary analysis appears to indicate that IRS Ruling 68-108 unduly discriminates against the re-refining industry in non-highway lubricating oil markets, since it permits rebate of excise taxes on virgin oil products without permitting a rebate of taxes on reprocessed products.

8. At this time, the need for further regulatory action at the Federal level is not clear despite the fractionated state of the collection, re-refining and disposal system. Presently, some States with more critical needs are attempting to initiate programs to address specific problems. The progress of such states should be monitored in order to utilize the experience gained from such programs. Most importantly, the benefits and costs of further regulatory programs needs to be examined. States are encouraged to continue to develop such control programs where warranted and to include where necessary the following elements:

a. approved waste oil disposal methods

b. licensing of collectors

c. approved waste oil disposal facilities

d. collection stations for receiving small quantities of waste oil

e. supervised record keeping by collectors and users of waste oil

f. re-refining of waste oil in virgin crude refineries.

Finally, it appears appropriate to examine the need for further regulatory action at a future date as experience is gained with State programs and as more other information becomes available on environmental and energy concerns.

Recommendations

1. Present Federal Trade Commission regulations require all products made from waste oil to be so labeled. For cases wherein a waste oil product can meet required specifications, the labeling regulation should be reexamined to eliminate the connotation that a product made from waste oil is inferior. In such cases, in order to protect the consumer, the label should give information as to what quality and performance specifications the oil will meet regardless of origin. Designations such as "made from used oil" should not be required.

2. IRS Ruling 68-108 should be reexamined to determine the feasibility of allowing non-highway users of re-refined oil to obtain refunds of taxes paid on virgin oil blended with re-refined lube. In the course of such a reexamination consideration should be given to the administrative feasibility and the effects on the lube oil market of such a reversal.

SECTION II

INTRODUCTION

Approximately 2.2 billion gallons of new lubricating oils were sold in the United States during 1972 (1). While figures vary widely on the subject, it is estimated that 50% of these oils are consumed in their various uses (2). The remaining 1.0 to 1.3 billion gallons of waste oil are potentially available for recycling and reuse. This volume is expected to grow at a rate of two percent per annum (3). The uncontrolled disposal of waste oil in sufficient concentrations over space and time can cause environmental damages. Waste oil probably poses the greatest threat to the environment through potential ground water and stream contamination, and by its heavy metals content (lead is the prime concern in waste crankcase oils).

Congress recognized that the disposal of waste oil could be a problem. Hence, in passing the 1972 Federal Water Pollution Control Act, (hereafter called the Act) Congress, in Section 104(m), mandated the Administrator of the Environmental Protection Agency (EPA) to "...conduct a study of (A) the generation of used engine, machine, cooling, and similar waste oil, including quantities generated, the nature and quality of such oil, present collecting methods and disposal practices, and alternate uses of such oil; (B) the long-term, chronic biological effects of the disposal of such waste oil; and (C) the potential market for such oils, including the economic and legal factors relating to the sale of products made from such oils, the level of subsidy, if any, needed to encourage the purchase by public and private non-profit agencies of products from such oil, and the practicability of Federal procurement, on a priority basis, of products made from such oil." The results of EPA's study are to be embodied in a report to Congress.

It should be emphasized that not all oily wastes fall within the scope of the definition provided within Section 104(m) of the Act. While the section calls for a study of "used engine, machine, cooling, and similar waste oil, it excludes (by specifically not including) animal and vegetable oils and unused mineral oil wastes (the wastes from drilling, refining, or transporting petroleum). The definition does include mineral oils and mineral oil products which have been used in machines, axles, transmissions, transformers, turbines, cable or circuit breaker insulation, and spindles. It was decided to exclude from the analysis tanker, bilge and other oil wastes from port facilities, since discharges from these sources are specifically covered in another section of the Act.

An attempt is made in the report to balance the need for additional energy sources required in the form of fuel with the need for preserving our supply of lubricating oil stock. The ultimate optimum reuse of waste oils must be determined on a case-by-case basis so that valuable resources are preserved.

A preliminary report on this study was submitted to the Congress on April 1973. This report fulfills the requirements of this section of the Act for a final report.

SECTION III

GENERATION OF WASTE OIL

Waste oils can be grouped into three broad categories: (1) automotive, (2) industrial and aviation, and (3) other waste oils. The automotive waste oils consist primarily of crankcase drainage (greater than 90%), waste transmission fluids, gear lubricants, hydraulic oils from automotive and construction equipment and minor amounts of kerosene and other solvents used in servicing equipment. Industrial and aviation waste oils consist of many types of oils and oil emulsions such as those used in metal working, lubrication of industrial equipment, hydraulic and circulating systems, railroad diesel engines, turbine lubrication, and those generated in aircraft engine overhaul facilities. Included in the general category of other waste oils are oils which have been used in transformers, heat transfer and refrigeration equipment, and in the myriad of equipment not included in the first two categories.

The amount of waste oil which is generated is a function of demand or sales. In 1972 the demand for lubricants was estimated by the Bureau of Mines at 2.2 billion gallons. Table 1 provides a categorized estimate of sales. Table 2 indicates the trends in domestic lube oil demand. Approximately one half of the total demand is automotive. It is interesting to note that automotive demand has been leveling off since 1965 and has not experienced an increase commensurate with gasoline sales because of the automotive industry recommendation of increased interval between oil changes. In the late 1950's oil was drained about every 2000 miles; oil in the late 1960's was drained between 4000 and 6000 miles. This is illustrated in Table 3, and Figure 1. Aviation requirements have fallen off drastically since 1958. This reflects the phasing out of piston engines and the phasing in of jet engines which use synthetic lubricants.

Little quantitative information is available as to the ultimate disposal of the 2.2 billion gallons of lubricating oil that are sold each year. However, reasonable estimates can be arrived at considering major points of generation and establishing waste oil generating factors that can be applied to sales figures. Table 4 indicates a rationale for converting automotive sales information to waste oil generation estimates. Using these factors for the automotive category and educated guess factors for the other categories, the total waste oil generated is estimated at 1.115 billion gallons. Table 5 provides the estimated generation data.

TABLE 1

LUBRICATING OIL SALES (4)
(millions of gallons)

Automotive Lubricating Oils		
Commercial engine oils fleet sales	200	
Commercial engine oils retail sales	90	
Factory fills (automotive & farm equipment	60	
Private automobiles	600	
Auto fleets, other	136	
Total automotive lubricating oils		1086
Industrial and Aviation Lubricating Oils		
Aviation lubricating oils	8	
Hydraulic and circulating system oils	325	
Metal working oils	150	
Railroad engine oils	60	
Gas engine oils	62	
Other	129	
Total industrial and aviation lubricating oils		734
Other Lubricating Oils		
Process oils	310	
Electrical oils	57	
Refrigeration oils	10	
Total other lubricating oils		377
Lubricating Oils Purchased by U.S. Government		37
GRAND TOTAL LUBRICATING OIL SALES		2234

TABLE 2

TRENDS IN DOMESTIC LUBE DEMAND (5)

Oils (Add 000 gal.)

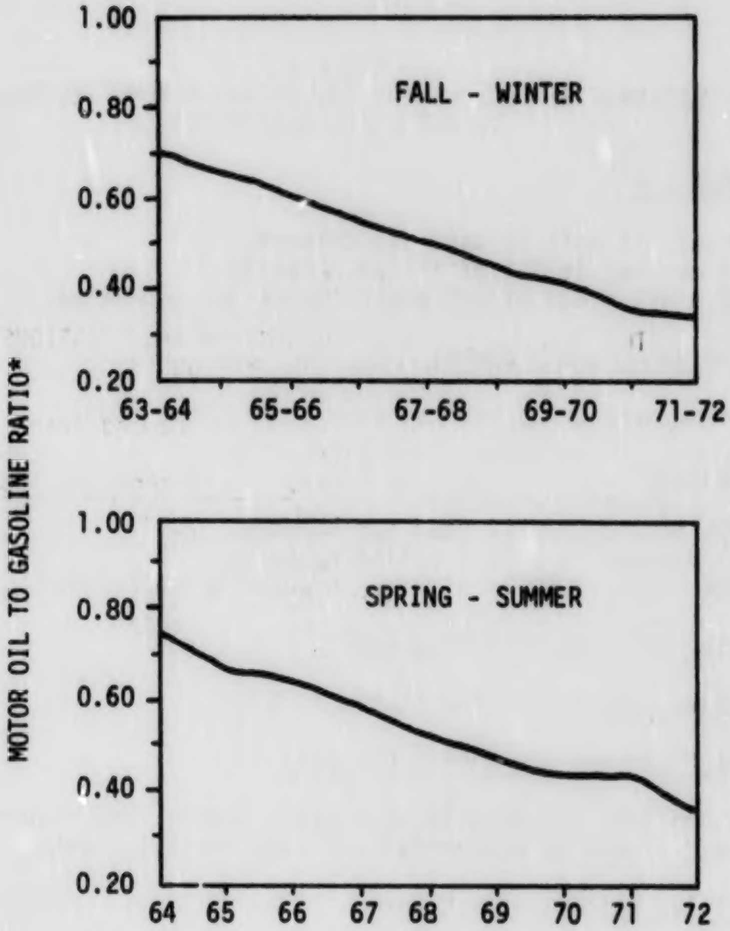
Year	Total	Automotive	Aviation	Industrials Lubricating	Other
1972	2,234,000	-	-	-	-
1971	2,193,755	1,071,065	8,434	726,000	388,256
1969	2,184,031	1,050,935	9,894	781,206	341,996
1967	2,058,953	1,031,784	13,064	699,120	314,985
1965	2,028,963	1,015,809	15,363	659,966	337,825
1962	1,766,094	945,493	22,157	510,823	287,621
1960	1,655,954	924,645	25,575	478,233	227,501
1958	1,555,234	899,562	27,327	415,206	213,139
1956	1,704,112	984,009	22,189	496,385	201,528

Source: Bureau of Census, Current Industrial Reports, Sales of Lubricating Oils and Greases

TABLE 3

AUTOMOTIVE LUBE DEMAND RELATED TO REGISTRATIONS AND GASOLINE CONSUMPTION (5)

	Registrations			Demand Trend		
Year	Total (000)	%Change	Gasoline 106 gals.	% Change	Lubes 106 gals.	% Change
1971	112,909	7.43	92,946	8.37	1,071	1.99
1969	105,097	8.40	85,764	10.79	1,051	1.84
1967	96,945	7.77	77,406	7.15	1,032	1.57
1965	90,370	14.35	72,240	8.51	1,016	7.51
1962	79,023	6.93	66,570	4.82	945	2.16
1960	73,901		63,504		925	



* Number of gallons sold in service stations per 100 gallons of gasoline. Sales in other retail outlets has some effect on this down trend.

Figure 1 - MOTOR OIL RATIO TREND*(5)

TABLE 4
ESTIMATE OF FACTORS FOR CONVERTING AUTOMOTIVE SALES TO WASTE OIL QUANTITIES (6)

Service Stations

70% of oil sold is used for changes.
Oil drained is 90% of filled capacity.
70% x 90% = 63% of Oil sold - waste oil generated.

Garages and Auto Supply Stores

Assume average is same as service stations (63%).

New Car Dealers

100% of oil sold is used for changes.
Oil drained is 90% of filled capacity.
100% x 90% = 90% of oil sold = waste oil generated.

Retail Sales for Commercial Engines

Assume same as service stations (63%).

Automotive Fleet and Other Lube Oil Uses

Assume 50%, allowing for two-cycle engines and internal use, e.g. fuel, by commercial and governmental fleets.

Factory Fills, Automotive and Farm

Assume 90% recovery as in automotive service centers.

Oil Bought at Discount Stores

Assume same as service stations (63%).
Assume 35% of waste oil generated finds its way to service stations.
63% x 35% = 22% of oil sold = waste oil generated at service stations.

TABLE 5

WASTE OIL GENERATION (6)
(millions of gallons)

	Sales	W.O. Factor	W.O.
Automotive Lube Oils			
Service Stations	270	.63	170
Garages, auto supply stores	60	.63	38
New car dealers	102	.90	92
Retail sales for commercial engines	90	.63	57
Auto fleet & other lube oil uses	136	.50	68
Factory fills (auto & farm equip.)	60	.90	54
Discount stores	168	.22	37
Commercial engine fleets	200	.50	100
	1086		616 *
Industrial and Aviation Lube Oils			
Hydraulic & circulating system oils	325	.42	137
Metal working oils	150	.42	105
Railroad engine oils	60	.53	32
Gas engine oils	62	.90	56
Aviation & other	137	.50	64
	734		394
Other Industrial Oils			
Process oils	310	.10	31
Electrical oils	57	.90	51
Refrigeration oils	10	.50	5
	377		87
Lube Oils Purchased by U.S.	37	.50	18
GRAND TOTALS	2234		1115

* Other national estimates or extrapolations of estimates from regional data range from 400 to 730.

SECTION IV

PHYSICAL AND CHEMICAL CHARACTERISTICS OF WASTE OILS

WASTE AUTOMOTIVE LUBRICANTS

Included under waste automotive lubricants are drainage of crankcase oils, transmission fluid, differential gear lubricants, hydraulic oils from automotive and construction equipment and small quantities of solvents frequently used in servicing automotive equipment. Automotive oils contain additives to improve their properties. These are synthetic organic chemicals and contain sulfur, nitrogen, oxygen and metals. Typical high grade automotive lubricating oil formulations may contain as much as 20 percent proprietary, or additive compounds. A typical blend is shown in Table 6. The organic portion of these additives may be susceptible to losses, combustion and reactions such as those that occur with the lube oil; however, the inorganics concentrate in the crankcase as oil losses occur and make up oil is added.

The contaminants in the waste automotive oil can be classified as volatile products, materials soluble in oil, and materials insoluble in oil. The volatile components generally are water and fuel. The soluble materials include many of the additives originally placed in the oil such as viscosity index improvers and detergents. The insoluble materials include submicron size carbon particles and inorganic materials such as atmospheric dust, metal particles, metal oxides and lead oxides originating during fuel combustion (7). A typical analysis of waste oil is shown in Table 7. In addition to the metals noted here, there are a large number of other trace metals present in used lubricating oils including aluminum, copper, silicon, tin, sodium, and magnesium.

The Petroleum Analytical Research Corporation (9) in 1973 obtained and analyzed automotive waste oil samples from 13 cities selected from five geographical zones, namely: Pacific Coast, Rocky Mountains, Plains States, East Coast and Midwest Rural. From each city the samples included three from high volume service stations, one each from a truck (diesel) fleet, a taxi fleet and an off-the-road fleet. For each city a composite sample was made and analyzed. In addition one sample was obtained from waste oil collection services in each of seven cities located in the five zones. Table 8 summarizes the waste oil characteristics of the composited samples and the samples from the collection services. It is evident that appreciable amounts of lead, barium, calcium, and zinc are found in most used motor oils. The exact amount reported on a given sample depends to some extent on the analytical method used. There will be differences between values determined by emission spectroscopy and atomic absorption. Individual samples vary widely in metal content. Lead concentrations may vary by an order of magnitude. This has important implications for waste oil processing.

TABLE 6. TYPICAL GASOLINE ENGINE LUBRICATING OIL INGREDIENTS (6)

INGREDIENT	PERCENT
1. Base Oil (Solvent 150 Neutral)	86
2. Detergent Inhibitor (ZDDP-zinc dialkyl dithiophosphates)	1
3. Detergent (barium and calcium sulfonates)	4
4. Multi-functional Additive (dispersant, pour-depressant, VI improver-polymethyl-methacrylates)	4
5. Viscosity Index Improver (polyisobutylene)	5
	100

TABLE 7

TYPICAL WASTE AUTOMOTIVE OIL COMPOSITION (8)

Variable	Value
Gravity, °API	24.6
Viscosity @ 100 °F	53.3 Centistokes
Viscotity @ 210 °F	9.18 Centistokes
Flash Point	215 °F (C.O.C. Flash)
Water, (By Distillation)	4.4 Volume %
BS & W	0.6 Volume %
Sulfur	0.34 Weight %
Ash, Sulfated	1.81 Weight %
Lead	1.11 Weight %
Calcium	0.17 Weight %
Zinc	0.08 Weight %
Phosphorous	0.09 Weight %
Barium	568 ppm*
Iron	356 ppm*
Vanadium	5 ppm*

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* ppm = parts per million

TABLE 8

WASTE OIL PHYSICAL AND CHEMICAL ANALYSIS (9)

Test	Units	Composites* Range	Composites* Avg	Collection Service** Range	Collection Service** Avg
Water Content (Free)	Vol. %	0	0	0-2	.2
Water Content (Distillation)	Vol. %	1.2 - 16	5.0	2-24	8.9
Flash Point	° F.	195 - 390	304	205-360	287
Sulfated Residue	ppm (wt)	15300 - 34100	21340	5200-17400	12000
Lead Content	ppm (wt)	5066 - 11969	8204	1429-8745	4461
Barium Content	ppm (wt)	12 - 285	87	7-301	70
Calcium Content	ppm (wt)	784 - 2243	1228	182-1116	755
Zinc Content	ppm (wt)	688 - 1173	894	242-983	688
Phosphorous Content	ppm (wt)	490 - 1165	917	388-1075	743
ASTM Distillation to 450° F.	Vol. %	6 - 22	11		
Total Chlorine Content	ppm (wt)	2900 - 4700	3671		
Total Bromine Content	ppm (wt)	.1 - 27	6		
Sulfer Content	ppm (wt)	2898 - 4788	3833	1790-6573	3246
Copper Content	ppm (wt)	15 - 38	26		
Iron Content	ppm (wt)	24 - 434	220		
Magnesium Content	ppm (wt)	86 - 469	252		
Sodium Content	ppm (wt)	27 - 368	148		
Aluminum Content	ppm (wt)	43 - 27	11		

* Include 13 composites, one from each of 13 cities: Fort Lauderdale, Fla.; Decatur, Ga.; Pelham, N.Y.; Ballwin, Mo.; Columbia, Mo.; Los Angeles, Calif.; Sacramento, Calif.; Seattle, Wash.; Houston, Tx.; Minneapolis, Minn.; Salt Lake City, Utah; Phoenix, Ariz.; Cheyenne, Wy.

Each composite was made from 6 samples including 3 from service stations, one from a taxi fleet, one from an off the road fleet, and one from a truck (diesel) fleet.

** Include 7 samples, one each from collection services in Decatur, Pelham, Ballwin, Los Angeles, Sacramento, Houston and Minneapolis.

Additional properties typical of waste oil are shown in Table 9 illustrating the wide variations that may occur in the composition of waste automotive lubricating oils. These values directly affect the fraction of re-refined oil that can be obtained. They are important in assessing the degree of contamination of the used lubricant and in determining methods of processing to convert used oils into useful products. Used automotive lubrication oils may contain appreciable amounts of gasoline introduced by means of blow-by. They also may contain relatively large amounts of sediment and water, and large amounts of ash. Much of the ash is due to additives originally blended with the oil. However, a large fraction of the ash originates from the lead in the fuel and enters the oil by means of blow-by. These materials generally impair the use of spent lubricant either for further use as a lubricant or for other applications until they are removed. Although most motor oils compounded for modern internal combustion engines contain additives of organo-metallic nature, a large proportion of metals are introduced during use. Typically, the metals introduced by means of wear or combustion and corrosion are aluminum, copper, iron, lead, silicon and tin. Sodium, barium, calcium, zinc and magnesium frequently are added as compounds by the oil manufacturer to impart specific properties to the oil. As will be discussed in greater detail in other sections of this report, these metallic residues affect the ultimate treatment, use and disposition of waste crankcase oils.

It is interesting to note that the impurities found in used automotive lubricants are similar the world over. For example, Schilling reports French waste oils (11) to have a viscosity of 37 to 45 centistokes, bottom water and sediment of 2 to 8 percent, a water content ranging from 1 to 9 percent, and a gasoline dilution of up to 10 percent. Additional characteristics of used automotive lubricant oils have also been reported (12, 13). It is apparent that wide variations in composition may occur thus affecting the value of the waste oil for subsequent applications and affecting the ability to reprocess these materials.

Two major factors can be expected to change the future composition of waste automotive engine lubricants. First, the Clean Air Act Amendments of 1970 mandated that the emissions of specified pollutants from automobiles be sharply reduced by the 1975-76 period. In order to meet the prescribed standards, automobile manufacturers will generally use catalytic converters. Since the presence of emission products of lead and phosphorous additives in the exhaust gases will significantly impair the effectiveness of such systems, EPA determined that it was necessary to promulgate a regulation (14) providing for the general availability of lead- and phosphorous-free gasoline. This regulation becomes effective on July 1, 1974, in order that lead- and phosphorous-free gasoline will be available when the 1975 model automobiles are introduced. Lead-free and phosphorous-free are defined as a maximum of 0.05 grams of lead per gallon and 0.005 grams of phosphorous per gallon. This compares with typical current values of 2.0 to 2.2 grams of lead per gallon and 0.01 to 0.02 grams of phosphorous per gallon.

TABLE 9

USED AUTOMOTIVE LUBRICATING OILS

SELECTED PROPERTIES (10)

Property	Average	Range
Specific Gravity	0.917	0.896 - 0.965
Viscosity @ 100° F SUS	436.000	262 - 753
Carbon Res. Conradson	6.5	3.8 - 12.6
Ash, %	2.49	1.57 - 3.78
Bomb Sulfur, WT. %	0.44	0.26 - 0.52
Neutralization No.	6.67	4.00 -14.26
Benzene Insolubles, %	2.0	1.17 - 3.33
BS&W, %	6.3	3.2 - 9.3

WASTE INDUSTRIAL LUBRICATING OILS

Waste metalworking lubricants originate from the manufacture of various machinery articles. These include oil-based fluids used without water, and emulsified aqueous fluids consisting of physical mixtures of oil and water plus certain additives. Metalworking lubricants may be classified (18) into two broad classifications. These are shown in Table 10. Under use, these coolants and lubricants are subject to deterioration and degradation caused by bacteria, heat, metal particles, oxidation, introduction of contaminants from water used to make the lubricant emulsions, and the introduction of tramp oil and grease. In many cases, the metalworking fluids are recirculated, settled, filtered and subjected to other forms of purification enabling their reuse in the plant; nevertheless, large quantities of these fluids must be disposed of. Both primary metal industries performing rolling and shaping of ferrous and nonferrous metals, and hardgood manufacturers such as automotive and appliance manufacturers, generate significant quantities of waste oils. These oils are heavily contaminated with oxidized lubricant materials, sediment, and finely divided hard-to-filter particles. In general, used metalworking lubricants must be handled separately from other waste oils primarily because of their composition.

The physical and chemical characteristics of a variety of other industrial waste oils depend on the specific application and composition of the original lubricant or oil. Typically, these wastes consist of spent turbine oil, spent transformer oil, mixtures of aviation jet fuel and lubricants, gear box oils from industrial rotary machinery, heat transfer fluids, and railroad lubricants.

Turbine oils have a long life and usually are inhibited to prevent oxidation, rusting and foaming. Although most turbine systems have on-line purification equipment of some type, impurities tend to build up necessitating flushing and changing of these lubricants. The oil volume in the turbine system can range from 4,000 gallons for a 300 megawatt generator up to 18,000 gallons for a 1,000 megawatt generator (19). Thus, accidental contamination of a turbine oil system can result in a large amount of waste oil suddenly being made available. Usually the viscosity of turbine oils range from 150 to 400 SSU at 100°F, although manufacturers do produce special products with viscosities around 900 SSU at 100°F. A typical turbine oil has a viscosity of 220 at 100°F, a viscosity index of 110, a flash point of 440°F, a pour point of 15°F and a neutralization number of 0.1, plus additives to control oxidation and foaming (20).

Transformer insulating oils must be maintained at a degree of purity necessary to maintain their insulating properties. Three measures of the performance of transformer oils currently are in wide use. These include dielectric tests, neutralization number, and interfacial tension.

TABLE 10

OIL-BASED METAL WORKING LUBRICANTS (18)

CLASS I. OILS AND OIL BASE FLUIDS

- A. Mineral Oils - Uncompounded
- B. Fatty Oils
  - 1. Uncompounded
  - 2. Fatty Oils containing Chlorinated Compounds
  - 3. Fatty Oils containing Sulfurized Compounds
  - 4. Fatty Oils made by combining B-2 and B-3
- C. Mineral Oils - Compounded
  - 1. Mineral Oil/Fatty Oil Blends
  - 2. Sulfurized and/or Chlorinated Mineral Oil
  - 3. Mineral Oils containing Sulfurized Fatty Compounds and/or Sulfurized Non-Fatty Compounds
  - 4. Mineral Oils containing Chlorinated Fatty Compounds and/or Chlorinated Non-Fatty Compounds
  - 5. Mineral Oils containing Sulfo-Chlorinated Fats or Sulfo-Chlorinated Non-Fatty Compounds
  - 6. Mineral Oils made by combining C-3 and C-4
  - 7. Mineral Oils and/or Fatty Oils containing Nitrogen or Phosphorus Compounds or Solid Lubricants, etc. in addition to Compounds from the groups employed in C-1 through C-6

CLASS II. AQUEOUS EMULSIONS AND DISPERSIONS

- A. Oil in Water Emulsions (Soluble Oils)
  - 1. Mineral Oil - Emulsions of Class I-A
  - 2. Mineral Oil/Fatty Oil - Emulsions of Class I-B(1) or I-C(1)
  - 3. Heavy Duty or Extreme Pressure - Emulsions of Class I-C(2) through I-C(7)
- B. Water in Oil Emulsions
  - 1. Mineral Oil - Emulsions of Class I-A
  - 2. Mineral Oil/Fatty Oil - Emulsions of Class I-B(1) I-C(1)
  - 3. Heavy Duty or Extreme Pressure - Emulsions of Class I-C(2) through I-C(7)
- C. Colloidal Emulsions
  - 1. Regular - Emulsions of Clss I-A
  - 2. Fatty - Emulsions of Class I-B(1) and I-C(1)
  - 3. Heavy Duty or Extreme Pressure - Emulsions of Class I-C(2) through I-C(7)
- D. Dispersions
  - 1. Physical Dispersions of Liquid (Class I) Materials

Dielectric tests (expressed in kilovolts) reveal the moisture content of the oil. The neutralization number (normally expressed as milligrams of potassium hydroxide per gram of oil sample) reveals the acid content and thus the degree of deterioration of the transformer oil. The interfacial tension (normally expressed as dynes per square centimeter) reveals the amount of sludge in the oil. New oil normally has an interfacial tension of 45 dynes per square centimeter and neutralization number of less than 0.1 milligrams of KOH per gram. The dielectric strength normally is greater than 25 Kilovolts (21). The interfacial tension normally is measured between the oil sample and a layer of distilled water. As the oils are subjected to the stresses, both thermal and electrical within the transformer, they deteriorate forming various acidic materials and accumulating moisture. Although these oils can be reclaimed, frequently their condition becomes poor enough to warrant disposal and replacement. Normally when the interfacial tension decreases to as low as 16 dynes per square centimeter, corresponding to a neutralization number of about 0.8, a sludging condition has developed in the transformer and the oil must be reprocessed or disposed of. Some of the physical property control methods used for transformer oils appear suitable for other industrial oils as well.

A small amount of fireproof transformer oils such as commercial mixtures of trichlorobenzene and polychlorinated biphenyls enter into the waste category each year. However, because of the persistent nature and non-biodegradability of these materials, they normally are disposed of by controlled incineration in approved facilities.

Waste gear oils usually are mixed with other plant oily wastes for ultimate disposal. These gear oils have SAE numbers ranging from 80 up to 250. Frequently they contain sulfur-bearing additives, antioxidants, and other additives. After use, these lubricants become contaminated with dirt, wear metal, water, and products of oxidation. Since they have properties similar to automotive crankcase lubricants, they may be included with them for re-refining or other means of disposal.

In addition, EPA has promulgated regulations (15) requiring a general reduction in the amount of lead additives used in gasoline. These regulations serve to protect the health of the general public by reducing the amount of lead introduced to the environment. These regulations become effective on January 1, 1975. To minimize economic dislocation, the regulations call for the phased reduction of the lead additives in relation to total amount of gasoline produced by a company.

The promulgated schedule restricts the use of lead in a refinery's total gasoline pool according to the following schedule:

Year	Allowable Lead in Total Pool (gr/gal)
1975	1.7
1976	1.4
1977	1.0
1978	0.8
1979	0.5

This schedule is designed to accomplish a 60 to 65 percent decrease in lead usage from base 1971 by supplementing the expected increasing use beginning in late 1974 of lead-free gasoline by new automobiles with catalytic emission control systems.

It is expected that the decrease in the average amount of lead in waste oil will parallel the schedule given above with adjustments for greater numbers of cars on the road each year. However, it should be remembered that two types of waste oil will be generated; (1) oil from cars that used lead-free gasoline, and (2) oil from cars that used leaded gasoline in which the lead content is gradually phased-down. Were it possible to segregate these two types of oil at the oil change level, a potentially useful supply of unleaded waste oil could be made readily available. EPA's latest estimates indicate the following portion of the gasoline market will be unleaded in the years to come:

Year	Percent of Pool Lead-free
1974	5
1975	15
1976	30
1977	44
1978	53
1979	63
1980	72

The percent of the waste oil pool which would be relatively lead-free should generally parallel the percentage of lead-free gasoline sold.

All recent information indicate few if any other effects on waste oil from removal of lead from gasoline. Although some minor changes in gasoline formulation will occur in order to compensate for the removal of lead additives, no significant changes in the composition of the waste oil are expected other than the reduction in lead.

The removal of lead from gasoline will have no effect on fuel economy; however, fuel economies associated with the catalytic converter are being shown to average 8 percent higher than 1973/1974 model cars, on a sales weighted basis. Furthermore, the recent energy shortage will likely lead the motorist to seek more fuel economy, e.g., smaller cars, and will also lead car manufacturers to attempt to improve fuel economies to the greatest extent possible. Thus, we might expect that the amount of gasoline consumed per unit of motor oil will tend to decrease in the future. This will further decrease the amount of lead in waste oil.

The use of unleaded and low lead fuels has been slight until now, and the changes in waste oil composition can not be predicted exactly. However, the removal of lead is a major problem in re-refining; therefore, the decrease in lead concentration may make re-refining more technologically and economically feasible. The decrease will also affect the use of this waste oil as a fuel.

SECTION V

METHODS OF COLLECTION AND DISPOSAL

COLLECTION

Collection is probably the weakest link in the entire waste oil recycling or reuse chain. At the present time it is estimated that there are between 1000 and 2000 collectors in the United States, most of which are concentrated in urban areas. Some are one truck operations and few have more than five trucks.

Some collectors are only in the collection business and derive their revenues from charging both the parties that they are collecting from and the parties that are recipients of the waste oil. In the past, when collectors have not been able to sell waste oil, they have disposed of it in landfills or in other ways that may or may not have been environmentally acceptable.

Another portion of the collection industry blends the waste oil with fuel oil (with or without any processing) and sells the resulting mixture as a fuel. Some of these operators are significant factors in the local industrial fuel market and will acquire waste oil collected by independents as well as that collected by their own trucks.

The last major segment of the industry is composed of those processors and re-refiners who operate their own collection fleets. Most of these collectors will fall into the category of reprocessors who dehydrate the oil and then use it in asphalt mixes or as road oil. Only a few of the re-refiners operate their own collection trucks.

None of the major, or even the smaller, oil companies collect waste oil. They do, however, encourage their dealerships, whether franchised or owned, to dispose of their oil to acceptable collectors. This is often written directly into the franchise contract.

Facilities at modern gasoline stations for collection of oil normally include a 500 to 1,000 gallon waste oil tank. Oil, solvents, grease drippings and related products often find their way into these tanks. The tanks are then periodically emptied by an independent collector. The gas station owner, or operator, does not concern himself with the ultimate disposal of the waste oil. Location, time of year, market conditions and oil quality determine whether oil will be dumped or sold for some type of reuse. Under current and forseeable market conditions essentially no oil is being dumped by collectors.

Collection is normally carried out by tank wagons with capacities of between 500 and 2,000 gallons. Until recently, hauls of over 50-100 miles were usually uneconomical, accounting for the concentration of collectors in the urban areas. In rural areas these tank trucks can not operate economically and there is no viable collection system. In 1972 collection costs varied between 1¢ and 4¢ per gallon. Presently the economics of waste oil collection is in a state of flux due to the shortage in fuel oil.

Based on a model study carried out by the State of Maryland (22), it is anticipated that oil can be collected for between 1¢ and 3¢ per gallon. A system of intermediate storage plants and 2,800 gallon tank trucks, for local collection, are proposed. These regional collection systems would then feed into a central reprocessing, or disposal facility utilizing 6,000 gallon over-the-road tank trucks to bring the oil to the central facility. The system would require approximately 20 trucks and cost 3¢ per gallon to operate. The initial investment would be approximately $300,000 for the State of Maryland, assuming the utilization of many existing storage tanks. A computer program has been developed to design and optimize such a system for the State of Maryland and this could be applied to other regions of the country. It should be noted that the system, as envisioned, will cover all areas of Maryland, urban, suburban, and rural.

If the collection problem can be solved in an economical manner, then it will be possible to dispose of the oil in an acceptable manner. The solution of the collection problem will depend on establishing collection systems throughout the country, enforcing collection, and regulating the collection process through licensing and accountability records. Under the present economic climate of high oil prices, disposal by collectors contrary to environmentally acceptable means is unlikely, but in times of plentiful oil, this may not be the case and adequate accountability is imperative.

No system has been developed to handle collection from the individual who purchases oil from a retail outlet and changes the oil in his automobile. The retail stores that sell oil to the home user have no provisions for collecting his waste oil; however, some communities are attempting to set up oil receiving facilities where the do-it-yourselfer may bring his oil. The do-it-yourselfer generally disposes of his oil with his trash, or by dumping it on his premises, or on a vacant lot, and in some cases by dumping it into a sewer. Ultimately some of this oil ends up in a landfill or in a watercourse. Because of the high degree of geographical dispersion of the do-it-yourselfers, it will probably not be possible to collect a significant fraction of this waste oil.

Collection of oil from individuals presents a more difficult problem. Local regulations requiring returnable containers would be required in those areas experiencing a problem to encourage the do-it-yourselfer to return his oil to a collection point affiliated with a suitable disposal facility. Table 11 provides an estimate of the quantities produced from various sources and how these materials were disposed of.

RE-REFINING

Petroleum re-refining is a small industry generally using old process technology and antiquated equipment. In the past re-refiners were considered marginal operators. The number of re-refiners as well as re-refining capacity has decreased over the years. In the early 1960s some 150 re-refiners produced an estimated 300 million gallons of re-refined products. In 1972 less than 40 companies produced an estimated 100 million gallons. The reasons for the reduction of this industry are both economic and technical.

Oils in recent years have become more complex because of the additives which are used to improve load carrying ability, as antioxidants, antifoam additives, corrosion inhibitors, detergents, dispersants, pour point depressants, viscosity index improvers, and color improvers. Table 12 illustrates the complexity of these additives. Extended drain periods have concentrated the additives, and increased the amount of impurities accumulated in the oil through combustion blow-by, engine wear and tear, and organic degradation. Costs associated with collecting wastes oils have increased, and certain tax advantages have been eliminated. Also, because of increased environmental awareness, the disposal of re-refining wastes have become more difficult and more costly. All of the foregoing together with inefficient plants, operating at less than design capacity, have generally eroded whatever price advantages re-refined oil had over virgin lubricants and have resulted in a drying up of the market.

A sample of 35 re-refiners indicates that the average processor has a 28,000 gal/day capacity and operates at 50 percent of that capacity. Capacities vary between 2000 and 90,000 gal/day. Reported plant sizes and limitations are summarized in Table 13.

Most of the waste oil presently being reprocessed is sold as motor or industrial lubes. The motor oil is usually sold through discount or food chains while industrial lubes are sold in bulk. According to preliminary studies conducted ty the Bureau of Mines, this oil if not compounded (no additives added) lacks lubricating power (13).

The recent energy shortage has mitigated the economic uncertainty which the waste oil re-refining industry faces. As of December 1973, re-refiners using the acid-clay process were receiving between 9.6% and 53.5% return on investment. This compares to less than a 1% investment in July 1973. The industry today appears to be on the threshold of increasing prosperity.

TABLE 11

GENERATION, DESTINATION, AND DISPOSAL OF WASTE OILS (1972)

(millions of gallons)

Category	Generated Waste Oil	To Reprocessors	To Re-refiners	Road Oils Asphalts	Fuel	Other
Automotive	616	202	105	142	19	148
Industrial and Aviation	394	130	16	25	118	112
Other Industrial	87	28	3	6	25	25
U. S. Government	18	4	3	4	4	3
TOTAL	1115	364	127	177	159	288
Reprocessed oils		-364		36	310	18
Re-refinery Waste			-41		10	31
ULTIMATE DISPOSAL		0	86	213	479	337

TABLE 12

COMPOSITION, APPLICATION AND FUNCTION OF LUBRICATING OIL ADDITIVES (22)

Name of Additive	Composition	Application	Function
Corrosion Inhibitor	Zn and Ba dithiophosphates, dithiocarbamates, metal sulfonates and sulfurized terpenes	IC engines, alloy bearings, ATF	To react with metal surfaces to form a corrosion-resistant film
Rust Inhibitor	Sulfonates, alkylamines, amine phosphates, alkenylsuccinic acids, fatty acids and acid phosphate esters	IC engines, turbines, electric and mechanical rotary machinery fire-resistant hydraulic fluids	To react chemically with steel surfaces to form an impervious film
Antiodorant	Perfumes, formaldehyde compounds	With EP additives	To mask odors
Antiseptic	Alcohols, phenols, chlorine compounds	With water added to oil-emulsions	To inhibit microorganisms
Antioxidant	Sulfides, phosphites, amines, phenols, dithiophosphates	IC engines, turbines, and rotary machinery	To inhibit oxidation of oil
Antifoam	Silicones, synthetic polymers, waxes	Same as rust inhibitors, excluding ball bearings	To permit air bubbles to separate from oil
Detergent	Sulfonates, phosphonates, phenates, alkyl substituted salitylates combined with barium, magnesium, zinc calcium	IC engines under steady load	To neutralize acids in crankcase oils to form compounds suspended in oil
Dispersant	Alkenyl sucinimides, alkyl--acrylic polymers, ashless compounds	IC engines at low temperatures and variable loads	To disperse contaminants in the lubricant

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Abbreviations: IC = Internal Combustion Engine: ATF = Automatic Transmission Fluid; EP = Extreme Pressure

TABLE 12 (Continued)

COMPOSITION, APPLICATION AND FUNCTION OF LUBRICATING OIL ADDITIVES

Name of Additive	Composition	Application	Function
Metal Deactivator	Organic dihydroxyphosphines, phosphites and sulfur compounds	IC engines, turbines, electric motors, air compressors, hydraulic oils	To form protective film on running surfaces to inhibit corrosion reaction
Color Stabilizer	Amine compounds	When heat and oxidation darken oil	To stabilize oil color
Viscosity Index Improver	Isobutylene polymers and acrylate copolymers	IC engines, electric motors, air compressors, hydraulic oils	To retard loss of viscosity at high temperatures
Pour Point Depressant	Polymethacrylates, polyacrylamides, alkylated naphthalenes and phenols	IC engines, gears, bearings, transmissions	To prevent congealing of oil at low temperature
Extreme Pressure Additive	Organic compounds with sulfur, phosphorous, nitrogen, halogens, carboxyl or carboxalate salt	IC engines, turbines, motors, hydraulic oils, gears, rollers and ball bearings	To form low-shear-strength film providing lubrication at startup and at high bearing loads
Antiwear Additive	Chlorinated waxes, organic phosphates, lead naphthenate	As above	As above except for running condition
Tackiness Agent	Polyacrylates and polybutenes	Gear enclosures from which oil must not drop	To improve adhesive qualities of base oil
Emulsifier	Surfactants, sulfonates, naphthenates and fatty acid soaps	Soluble cutting oils	To reduce interfacial tension and permit formation of water-oil emulsion

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Abbreviations: IC = Internal Combustion Engine; ATF = Automatic Transmission Fluid; EP = Extreme Pressure

TABLE 13. SURVEY OF WASTE OIL RE-REFINERS

XX=MAJOR
X=MINOR

	PROCESS			PRODUCT CAPACITY, GPD		SOURCES OF FEED				PRODUCTS		
COMPANY	ACID	CLAY*	OTHER	DESIGN	OPERATING	CRANKCASE OIL	RR DIESEL	INDUSTRIAL OILS	OTHER	LUBE & TRANSMISSION OILS	OTHER	COMMENT
1.		x	--	10,000	7,000	xx	--	--	--	xx	Fuel oil (10%)	
2.	x	x	--	25,000	10,000	xx	--	x	--	xx	Gear oil, compressor oil	Experimenting with acid sludge lime mixture for disposal as powdered sludge
3.	x	x	--	24,000	12,000	xx	--	--	--	xx	Penetrating oils	
4.	x	x		20,000	8,000	xx (70%)	x (20%)	x	--	x	Journal box oil	Propane extraction (inactive)
5.	x	x	--	25,000	20,000	xx			All types of waste oils	xx	--	
6.	--	x	Caustic soda/ silicate	--	6,500	xx	x			xx	--	
7.	--	x	Pre-treatment of feed & distillation	40,000	25,000	xx	--	x	--	xx	--	

TABLE 13. SURVEY OF WASTE OIL RE-REFINERS (Continued)

XX = MAJOR
X = MINOR

	PROCESS			PRODUCT CAPACITY, GPD		SOURCES OF FEED				PRODUCTS		
COMPANY	ACID	CLAY	OTHER	DESIGN	OPERATING	CRANKCASE OIL	RR DIESEL	INDUSTRIAL OILS	OTHER	LUBE & TRANSMISSION OILS	OTHER	COMMENTS
8.	x	x	--	8,300	5,200	xx	--	x	--	xx	Industrial oil (60%)	1.5 mm gal. storage capacity
9.	x	x	Caustic pretreatment	2,500	1,800	xx	--	--	--	xx	--	
10.	--	--	--	45-90,000 25,000	20-30,000 (fuel) 2,000 (lube oil)	x	--	xx	animal oils	x (10%)	Fuel (90%)	Planning to stop lube oil processing
11.	--	x	--	--	2,000	xx	--	--	--	xx	Hydraulic oil, machinery lubricants	Plans 25% expansion
12.	--	--	not specified	8,300	8,300	xx	--	--	--	xx	Fuel (minor)	2 mm gal storage capacity
13.	--	x	Multistage continuous distn.	26,000	12,000	xx	--	xx	--	xx	Industrial oils, transmission oils machinery lubricants	
14.	x	x	--	--	12,000	x	--	--	--	x	Asphalt flux oil	Planning modernization

TABLE 13. SURVEY OF WASTE OIL RE-REFINERS (Continued)

XX = MAJOR
X = MINOR

COMPANY	PROCESS			PRODUCT CAPACITY, GPD		SOURCES OF FEED				PRODUCTS		
	ACID	CLAY	OTHER	DESIGN	OPERATING	CRANKCASE OIL	RR DIESEL	INDUSTRIAL OILS	OTHER	LUBE & TRANSMISSION OILS	OTHER	COMMENTS
15.	x	x	--	48,000	40,000	x	x	--	--	xx	Journal box hydraulic,	Planning modernization
16.	x	x	Continuous	--	2,000	x	--	x	--	x	Hydraulic, fuel, spray form oils	Trying to sell out
17.	x	x	de-emulsif. of ind. oil	22,000	22,000	x	--	x	Soluble & cutting oils	xx	Road, hydraulic oils.	Some custom industrial work
18.	x	x	--	8,000	8,000	x	--	x	Watered fuels, transformer	xx	fuel, asphalt blending oil	Planning to rotary vac. filter odor from water petroleum
19.	x	x	Dewater & filter indust. oils.	25,000	25,000	x	--	Cutting & other indust. oils.	--	xx	Industrial oils	Expanding capacity considerable custom indus. work had had polychlorinated biphenyl problem-acid sludge neutralized before disposal

TABLE 13. SURVEY OF WASTE OIL RE-REFINERS (Continued)

XX = MAJOR
X = MINOR

	PROCESS			PRODUCT CAPACITY, GPD		SOURCES OF FEED				PRODUCTS		
COMPANY	ACID	CLAY	OTHER	DESIGN	OPERATING	CRANKCASE OIL	RR DIESEL	INDUSTRIAL OILS	OTHER	LUBE & TRANSMISSION OILS	OTHER	COMMENTS
20.	x	x	--	--	6,000	x	--	--	--	xx	Transmission oil, form & spray oil (little processing)	Trying to sell out
21.	x	x	--	9,000	8,000	x	x	--	--	xx	Journal box oil, diesel lubes	No longer has site for acid sludge disposal may go to dehydration only to make fuel.
22.	--	--	Distillation	30,000	--	x	--	x	Contaminated fuels	x	Fuel	None
23.	x	x	--	2,500	2,500	x	--	--	--	xx	form oil	
24.	x	x	Caustic	6,000	4,000	x	--	--	--	xx	--	
25.	x	x	--	4,000	4,000	x	--	--	--	xx	--	
26.	x	x	--	2,000	2,000	x	--	--	--	xx		
27.	--	--	Distillation	--	--	x	x	x	Jet Fuels, interface fuels	--	Fuels, asphalt flux	New re-refining process under devel. Customers segregate oils.

TABLE 13. SURVEY OF WASTE OIL RE-REFINERS (Continued)

XX = MAJOR
X = MINOR

COMPANY	PROCESS			PRODUCT CAPACITY, GPD		SOURCES OF FEED				PRODUCTS		COMMENTS
	ACID	CLAY	OTHER	DESIGN	OPERATING	CRANKCASE OIL	RR DIESEL	INDUSTRIAL OILS	OTHER	LUBE & TRANSMISSION OILS	OTHER	
28.	x	x	--	10,000	4,000	x	--	x	--	xx	--	
29.	--	x	--	15,000	6,000	x	--	x	Cutting and cooling oils	--	Journal oil, industrial oils	**Formerly did railroad bus. custom indus. work major business**
30.	x	x	--	6,000	6,000	x	--	--	--	xx	Hydraulic oil	
31.	x	x	--	7,500		x	--	x	--	--	Fuel Journal box oil	
32.	x	x	--	--	12,500	x	--	x	--	xx	Chain oil, chemical carrier	
33.	-	x	Distillation	25,000	5,000	x	--	--	--	--	Sweeping compound	
34.	x	x	--	2,400	1,900	x	--	--	Waste diesel fuel		Transformer oil	
35.	x	x	--	20,000	--	x	x	x	Solvents	x	Journal box oil, diesel lube	

* Normally includes an oil stripping step.

DISPOSAL BY LAND APPLICATION

Soils have been shown to provide a high degree of physical, chemical, and biological treatment for organic wastes. Despite their demonstrated efficiency in assimilating wastes, land spreading has never been used as extensively as it could be. Although used by many petroleum refineries, oily waste disposal by land spreading has not been generally appreciated and exploited by sanitation and pollution control officials. Several reasons are apparent for the practice having failed to be used more universally. Fear of pollution of surface and groundwater, using soils poorly suited to oil assimilation, and lack of information concerning successful full-scale operations are among the reasons.

When deep, fine-textured soils are used for disposal sites, oil added judiciously will adhere to the soils and move but little into them, thus eliminating danger of groundwater pollution. Only indiscriminate, heavy additions of oil to coarse, porous, or shallow soils would be expected to cause such pollution. Appendix A is a paper presented at the 5th International Water Pollution Research Conference (1970) describing land spreading as non-polluting method of disposing of oily wastes. A real disadvantage of this method of disposal of waste oil is that it appears potential as an energy resource.

The Environmental Protection Agency reported on a demonstration (26) of disposal of oily sludges by a soil cultivation process in Deer Park, Texas. In this demonstration nitrogen, potassium and phosphorus were added to stimulate microbial action.

Considerable amounts of waste oil are being used to oil roads for dust control. A limited study (27) has been carried out at the EPA's Water Quality Research Laboratory, Edison, New Jersey to evaluate the environmental significance of this disposal method. Two rural roads that had been treated with waste crankcase oils were examined. It is estimated that 30 percent of the oil applied volatilized or was biodegraded. Approximately 1 percent of the total oil estimated to have been applied to the roads over the 12 year period remained in the top inch of the road surface. The remaining 70 percent of the oil apparently left the roadway either on dust particees or in water runoff. These findings, however, are not necessarily typical. The road surface predominately clay and relatively impervious was heavily oiled. Under these conditions one would anticipate oil runoff. Proper use of waste oil as a dust palliative must take into consideration road surface material, road location and oil application rate.

USE AS A FUEL

Currently, burning as a fuel is a major outlet for waste oils. The increasingly favorable economics, environmental pressures to discourage indiscriminate dumping, and the decline in re-refining capacity, all have contributed to this increasing trend toward disposal by burning. The practice was well-established prior to the advent of the current energy crisis (Table 11), and a reasonable expectation would be that disposal of waste oils by burning for energy recovery will increase in the future, unless air pollution control technology, imposed to prevent lead emissions from waste oil combustion, makes burning uneconomical.

A survey performed in Massachusetts in 1967 by A.D. Little, Inc., (24) reported that the total quantity of 12.3 million gallons of waste automotive oil was generated in the state, and that 36.6 percent or 4.5 million gallons was reprocessed to fuel oil. The 4.5 million gallons reprocessed to fuel oil represented 60 percent of the 7.5 million gallons collected. In 1971, the Wisconsin Department of Natural Resources (25) reported that of the total quantity of 5.6 million gallons of waste automotive oil generated in 1971, 37 percent or 2.1 million gallons was reused as fuel oil.

As indicated in Table 1, 2.2 billion gallons of lubricating oils were sold in the Nation in 1971. The quantity of waste oil generated from these sources was estimated to be 1.1 billion gallons (Table 11). Of this an estimated 159 million gallons (14%) was burned directly for fuel. Waste oil processors disposed of an additional estimated 364 million gallons (33%) most of which was sold for fuel. Thus, an estimated 475 million gallons per year, or 42 percent of the total quantity of waste lubricating oil generated annually in the Nation are burned for fuel. The data on which the estimates are based was generated prior to the advent of the current energy crisis. A clear picture of the impact of the current energy crisis on the waste oil market has not evolved. One would expect, however, the trend toward burning waste oils will increase in the near future since the current energy crisis has put a premium price on all available energy sources.

Limitations on the burning of waste oils containing lead may be necessary and are discussed in Detail in Section III of this Report.

OTHER DISPOSAL METHODS

As indicated in Table 11 an estimated 337 million gallons or 30% is disposed of by other methods. At least 50 million gallons of this amount represents the oil in acid clay sludges and tank bottoms from re-refiners and reprocessors most of which is disposed of in landfills, and lagoons. Some portion is used for other legitimate uses such as the oiling of concrete forms in the construction industry. Some is disposed of in landfills and some is accidentally or intentionally dumped either on land or in water.

SECTION VI

RE-REFINING TECHNOLOGY

The major re-refining process in use today is acid/clay treatment. Another process used in the United States is vacuum distillation followed by the clay treatment which may or may not include a caustic pretreatment. Acid/clay treatment can produce a good lube stock; however, acid consumption and tar yields are high resulting in poor economics and a sludge disposal problem.

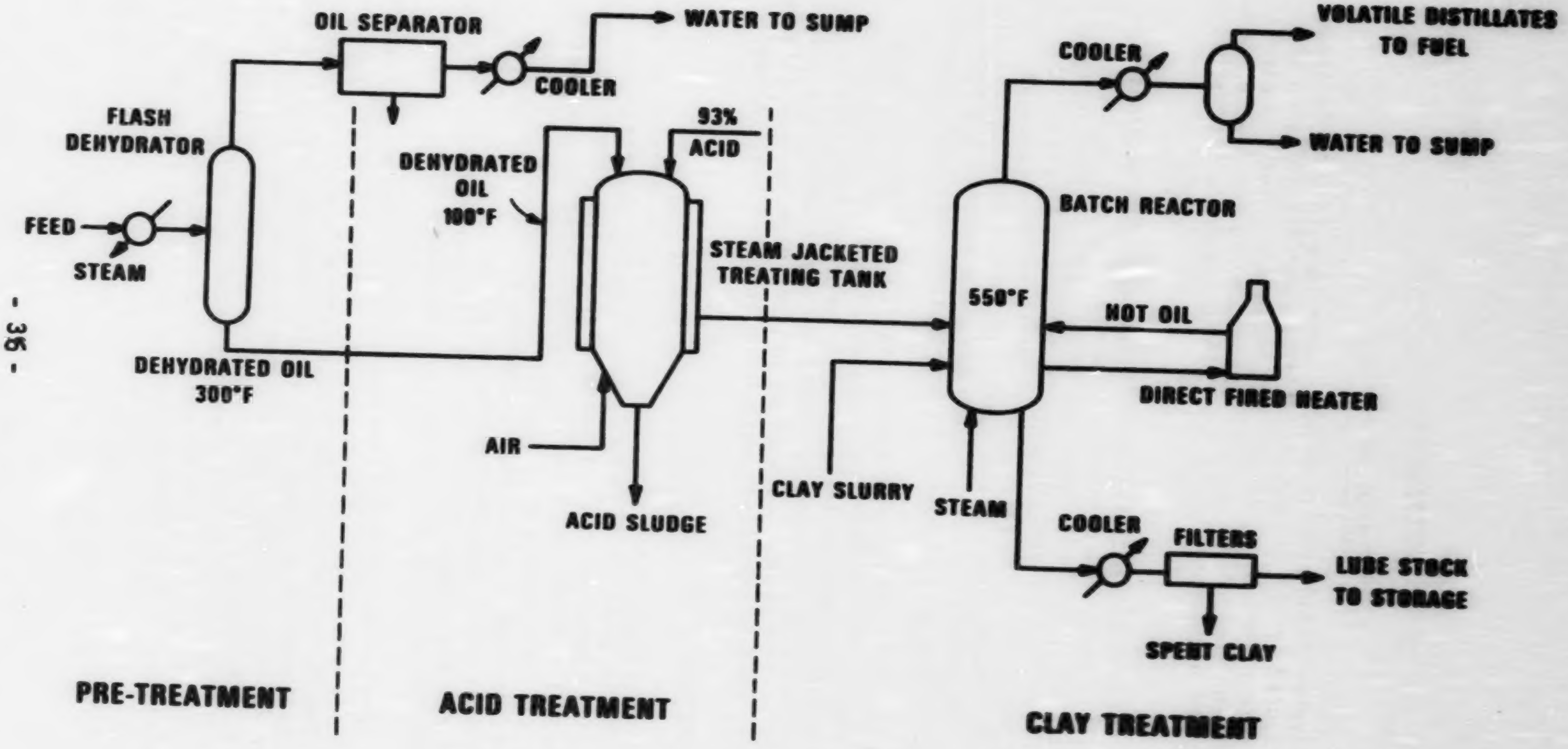
Although solvent extraction is old in the art of lube manufacturing, it has not, in the past, found favor with waste oil reprocessors. High solvent to-oil ratios result in high operating costs, and continuous operation requires skilled operating personnel. Finally, acid and clay treatment are not fully eliminated. Several firms have developed solvent extraction processes at pilot plant scale. Only the Institut Francais du Petrole (IFP) has commercialized the process. In Europe, a 9 million gallon per year plant using propane as the solvent, has been constructed.

The Environmental Protection Agency has funded a major program to develop a non-polluting re-refining process. The major emphasis in this program is the development of a distillation process preceeded by a pretreatment process or followed by hydrotreating to develop a stable lubricating oil. In addition, a bottoms product high in lead (13% lead and 25% solids) will be recycled, reclaiming lead and heat values.

ACID/CLAY TREATMENT

The process scheme for the typical acid/clay re-refining of waste automotive oils is shown in Figure 2. The incoming materials are unloaded into a partially submerged tank fitted with grids and screens to remove the debris normally found in the waste materials. After the free water settles, the oil is decanted and transferred to feed storage tanks. The feed is pumped through a steam heat exchanger to the flash dehydrator which operates at 300°F and atmospheric pressure. The steam/oil overhead is condensed and separated; the oil to the light end storage to be used for fuel, and the water to the wastewater disposal system.

The dehydrated oil is sometimes stripped prior to acid treatment but more often it is pumped directly to dry oil tanks, where it is stored and cooled. It can be stored for 2 to 4 days before it picks up appreciable moisture which tends to increase acid requirements during the following step. After 48 hours storage, the oil temperature has dropped to approximately 100°F. The dry oil is then pumped to one of the several acid treating units. These units are steam jacketed and are agitated with plant air. Sulfuric acid (92%) is added to a reactor maintained at about 100°F. The amount of acid added ranges between 4 and 6 percent of the


FEED
STEAM
FLASH DEHYDRATOR
OIL SEPARATOR
COOLER
WATER TO SUMP
DEHYDRATED OIL 300°F
DEHYDRATED OIL 100°F
93% ACID
STEAM JACKETED TREATING TANK
AIR
ACID SLUDGE
CLAY SLURRY
STEAM
550°F
BATCH REACTOR
COOLER
VOLATILE DISTILLATES TO FUEL
WATER TO SUMP
HOT OIL
DIRECT FIRED HEATER
COOLER
FILTERS
LUBE STOCK TO STORAGE
SPENT CLAY
PRE-TREATMENT
ACID TREATMENT
CLAY TREATMENT

RE-REFINING BY AN ACID CLAY PROCESS

Figure 2

reactor volume. The oxidized products contained in the oil are usually coagulated within 24 hours, but up to 48 hours may be required depending on the feed. The acid sludge, containing oil contaminants and ash, separates from the oil and is drawn off from the reactor bottom. Acid sludge disposal, which usually is done in landfills or lagoons, is one of the most critical problems in this process.

The acid treated, dehydrated oil is then transferred to the steam stripping-clay treatment operation. The clay treater is equipped with overhead condensing equipment and a direct-fired heater through which the oil is circulated. The capacity of the clay treater is usually on the order of 5,000 to 10,000 gallons. It is equipped with a sparger for direct introduction of steam.

The temperature of the batch is brought up to 500-600°F by circulating through the heater after the batch has been transferred. Simultaneously, live steam is introduced into the batch. The purpose of this stripping operation is to remove the remaining light fuel fractions and any mercaptans which may be present. This operation normally takes 12-15 hours to complete. The steam-stripped materials are condensed, and the oil separated from the water. The water fraction is treated through the wastewater disposal system and the oil fraction used as plant fuel.

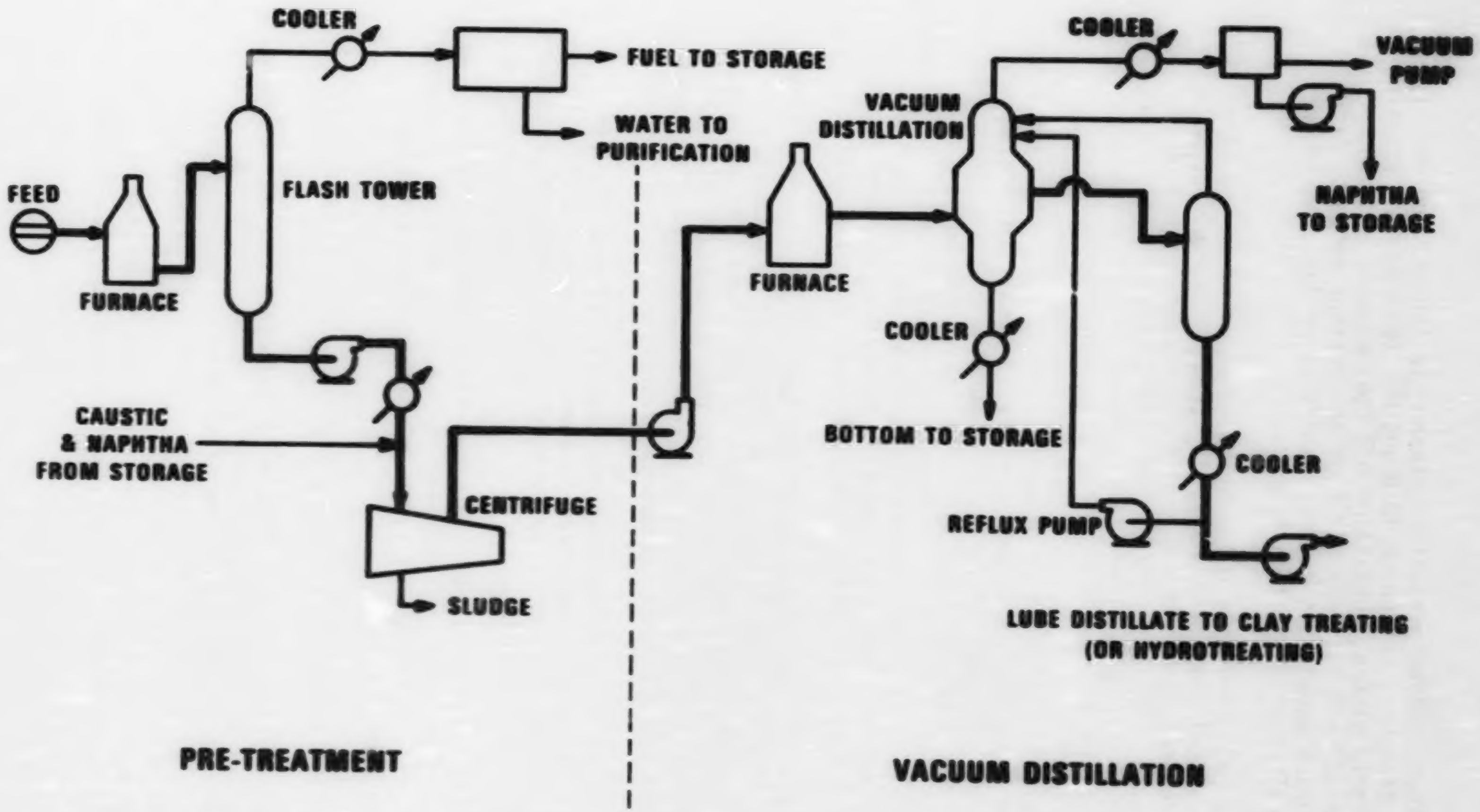
The heat is discontinued and part of the fuel oil is diverted to the clay slurry tank. The oil temperature is permitted to drop to approximately 400°F. The clay, often a 50% mixture of activated clay and diatomaceous earth (200-250 mesh), is mixed into the circulating oil. The clay dose is approximately 0.4 pounds per gallon of oil. The clay removes color bodies as well as colloidal carbon by adsorption.

The hot oil (250-350°F) containing the clay is filtered through a plate and frame filter press, sometimes followed by a second filter. The clarified oil is then stored either prior to or after having the necessary additives blended into the stock.

The filter cake, a mixture of clay, impurities, and oil, is discarded, usually into a landfill. This is becoming increasingly difficult to do. Paper often used as a filter medium in the plate and flame press is discarded with the cake.

DISTILLATION/CLAY TREATMENT

The distillation/clay process (Figure 3) overcomes the serious acid sludge waste disposal problem connected with acid/clay treatment. The collected waste oils are received in the usual manner, insuring that extraneous matter does not enter the process stream. The wet oil is heated to 300°F in a direct heater, using as fuel, light hydrocarbon streams generated during processing. The flash tower operates at atmospheric pressure and 300°F. The oil/water overhead is condensed


COOLER
FUEL TO STORAGE
WATER TO PURIFICATION
FEED
FURNACE
FLASH TOWER
CAUSTIC & NAPHTHA FROM STORAGE
CENTRIFUGE
SLUDGE
PRE-TREATMENT
COOLER
VACUUM PUMP
VACUUM DISTILLATION
NAPHTHA TO STORAGE
FURNACE
COOLER
BOTTOM TO STORAGE
COOLER
REFLUX PUMP
LUBE DISTILLATE TO CLAY TREATING (OR HYDROTREATING)
VACUUM DISTILLATION

VACUUM DISTILLATION OF CRANKCASE WASTE OIL

Figure 3

and sent on to an oil decanter. The water phase is separated and removed to the wastewater disposal system. The oil layer is used as fuel in the plant.

The flash tower bottoms are passed through a heat exchanger to reduce the temperature to approximately 100°F. Light oil, having a boiling range of 150-250°F is introduced into the dehydrated oil stream. The quantity used is approximately 20% based on oil volume. A small amount of caustic 0.2-2.0%, dependent on feedstock, is also introduced. The addition of the light oil and caustic tends to break the oil-water emulsion and precipitate solids. These materials are removed by centrifugation. The sludge from the centrifuge can be disposed of separately, e.g., by landfill, or it can be mixed with the distillate bottoms.

The naphtha/caustic/centrifuge pretreatment step may not be a necessary adjunct to distillation, but it does tend to eliminate some of the materials which can cause fouling and erosion in the vacuum distillation furnace, column, and associated heat exchangers. The centrifuged oil is then pumped to the vacuum distillation tower through a direct fired heater, where it is heated to about 700°F. The columns operate at a vacuum of 27 inches of mercury. The overnead naphtha is condensed, cooled and used a fuel in the plant.

The bottoms, which contain almost the entire ash content of the feed, are cooled and used as fuel, or blended into asphaltic products, or stored in a lagoon. The middle cut is sent on to clay treatment for finishing as a lube blending stock. The clay treatment is similar to that described for the acid/clay process except that prior stripping is unnecessary and may be reduced to as little as 0.125 lbs. of clay per gallon of oil. The filter cake is usually disposed of in a landfill.

The yields for this type operation, based on input oil, are approximately 70%, comparable to the best acid/clay treating operations. The product quality produced by the distillation/clay process as described is also comparable to that produced by acid/clay treatment; however, by taking more than one sidestream from the vacuum distillation column, it may be possible to obtain a part of the yield as higher viscosity lube stocks.

In some re-refining operations, odors can be adequately controlled by sealing open vessels and tanks, good housekeeping, and by venting process vessels to furnaces where vapors are burned with the normal fuel. Other plants have resorted to control methods such as caustic scrubbers.

The wastewater system varies from plant to plant, depending on cooling water and vacuum facilities, water runoff problems, land availability, water contamination of feedstocks, governmental regulations, and availability of a local sewage plant.

Overall lube stock yields for acid/clay treatment have been reported from 45 to 75%, depending upon operating conditions and feed composition, with water, sludge, ash and gasoline contents being most critical. The oil produced by the acid/clay process can be considered a solvent neutral blending stock, with properties approximating an SAE 20 lubricating oil. SUS (Saybolt Universal Second) viscosity is generally between 55 and 58 at 210°F. The oil can be blended to a finished lube by the re-refiner or sold directly to a jobber with blending facilities. Viscosity is increased by the addition of virgin bright stocks, or by the addition of polyisobutylene. To meet high performance specifications additive packages are introduced.

SOLVENT EXTRACTION AND CLAY TREATMENT

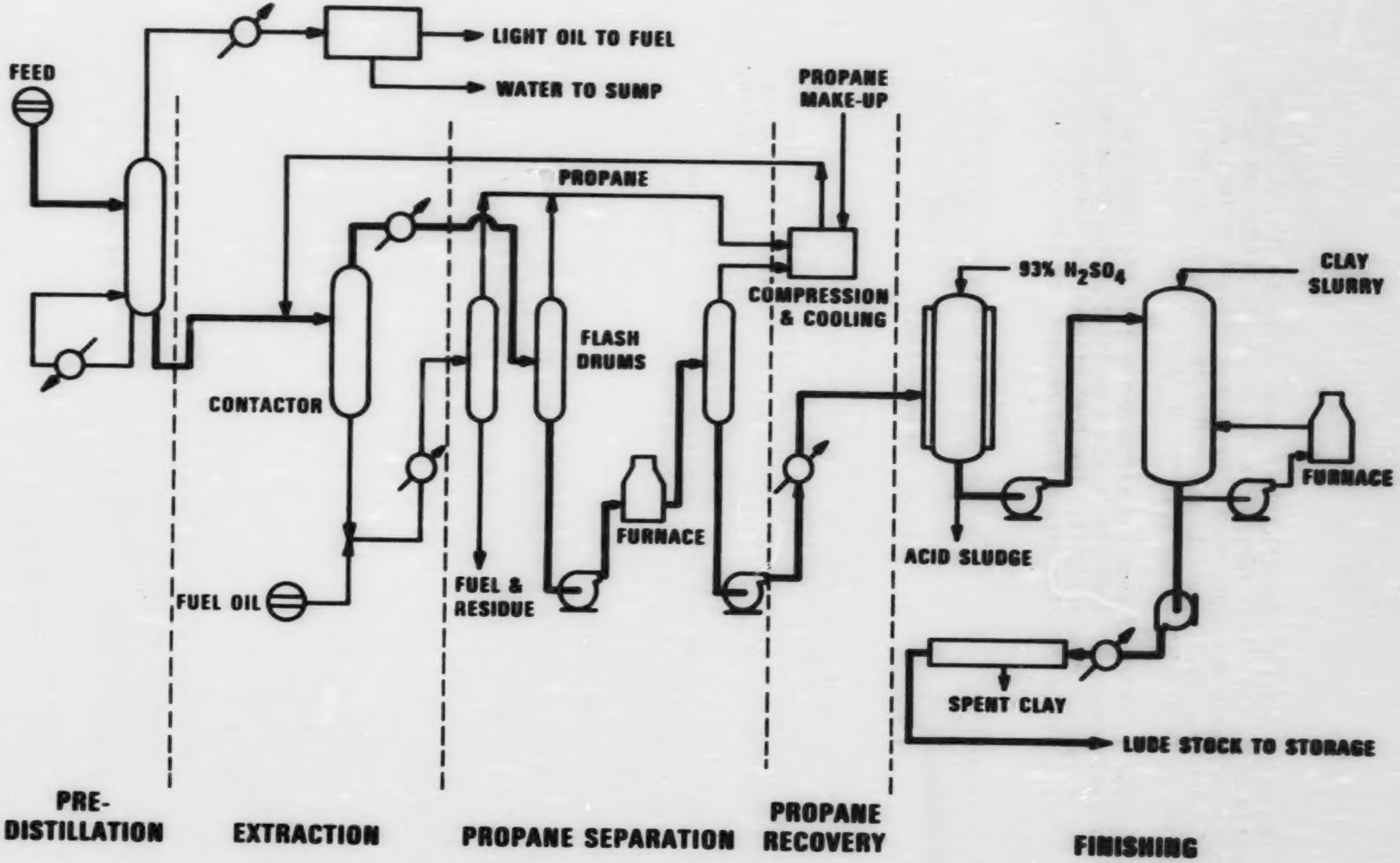
The solvent extraction/acid/clay process (figure 4) is a relatively new development in the re-refining of waste lubricating oils. It has been tried experimentally in the United States but no plants are now in operation. A 9-million gallon per year plant is operating in Italy based on a process developed by Institut Francais du Petrole (IFP). (28) Similar processes have been developed and patented, but not commercialized by U.S. firms.

The basis for the process is the use of propane to selectively extract the base lube stock from the additives and other impurities. The propane, containing dissolved oil, is removed from the extractor, while the high boiling, dark colored asphaltic and oxidized hydrocarbons and suspended solids are removed from the unit bottom as a residue. The bottoms are mixed with a fuel oil and used as plant fuel, or otherwise disposed of; whereas, the propane is flashed from the oil and recycled.

The process scheme consists of thermal dehydration, precipitation and solvent extraction, vacuum distillation, acid treatment, clay treatment, and filtration.

The incoming waste oil is unloaded into a receiving tank as described before. The feed for the process is pumped through the steam heat exchanger to the flash dehydrator operating at about 300°F and atmospheric pressure. The overhead is condensed and drained into an oil separator. The water layer is disposed of through the wastewater disposal system the oil layer is either stored or processed immediately in the solvent contactor.

The oil is pumped to the precipitation tower (solvent extractor) via a heat exchanger. The propane is also heated and introduced into the tower approximately 1/3 of the way up from the bottom. The oil is introduced 1/3 down from the top. The solvent extractor operates at about 500 psig and elevated temperatures. The propane-oil solution (the oil having dissolved in the solvent) goes overhead due to specific gravity differences, whereas the precipitate flows to the extractor bottom.


FEED
LIGHT OIL TO FUEL
WATER TO SUMP
PROPANE MAKE-UP
PROPANE
CONTACTOR
FLASH DRUMS
COMPRESSION & COOLING
93% H_2SO_4
CLAY SLURRY
FURNACE
FUEL OIL
FUEL & RESIDUE
FURNACE
ACID SLUDGE
SPENT CLAY
LUBE STOCK TO STORAGE
PRE-DISTILLATION
EXTRACTION
PROPANE SEPARATION
PROPANE RECOVERY
FINISHING

RE-REFINING BY A PROPANE EXTRACTION PROCESS

Figure 4

For very high quality lube oil, the solvent to feed ratio should be approximately 20:1. This will vary depending on the feedstock and must be determined for each and every feed. The lowest solvent to feed would be 1:1, yielding poor quality oil in the raffinate. Current operations use a solvent to feed ratio in the vicinity of 15:1.

The residue is released from the extractor by a liquid level controller. A small amount of fuel oil is added to the pipeline to assist in the flow of residue from the unit. The fuel oil-residue mixture is stored for use as a fuel for the direct fired heaters, or for other means of disposal.

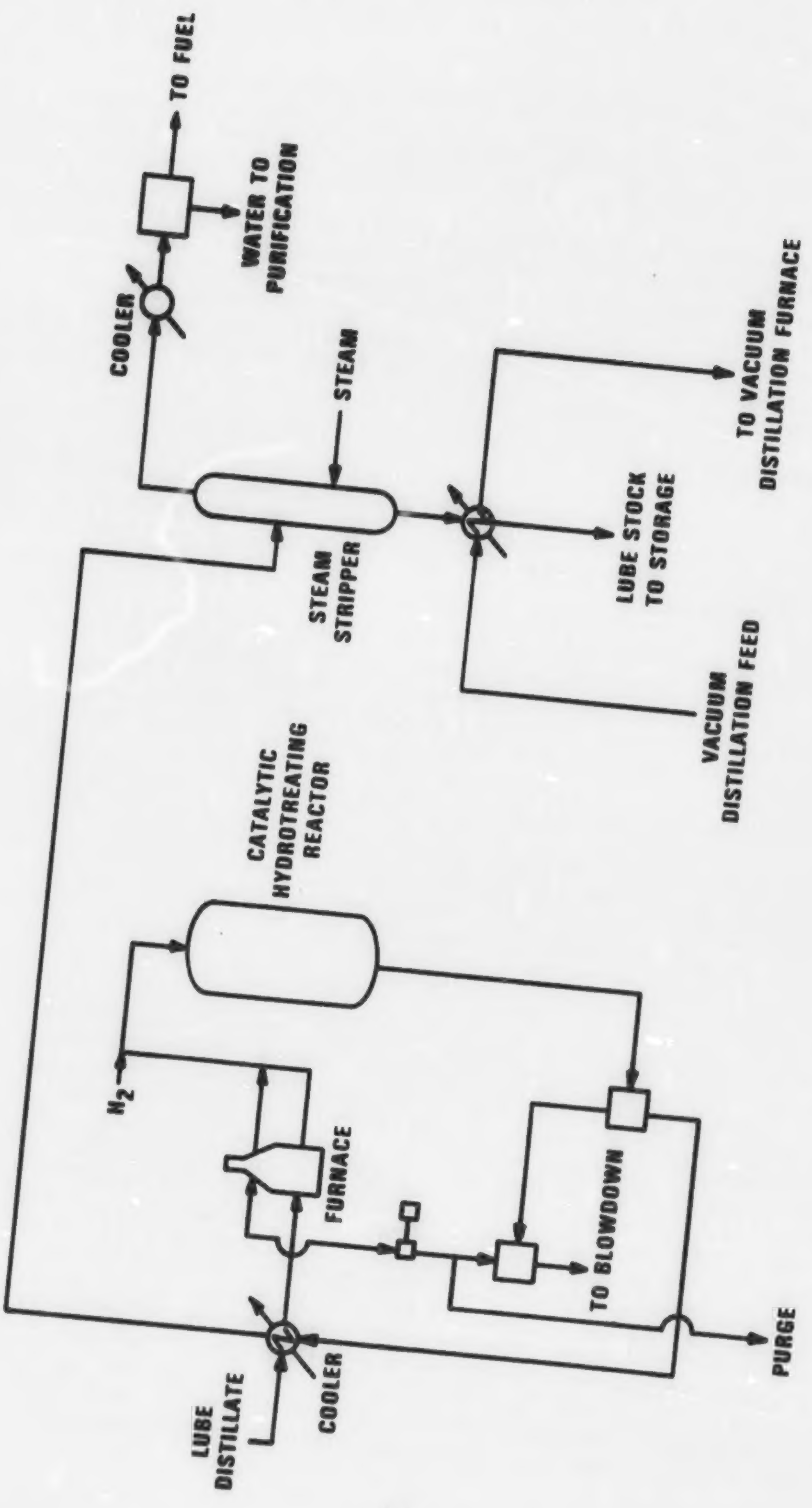
The propane-oil solution is flashed through a pressure reducing valve into a solvent flash drum. It is usual to use a two-stage flash to separate the propane and oil. The first stage operates at 250°F and 250 psig. The propane gas is liquified and recycled.

The lube oil is sent on to acid/clay treatment as described in the acid/clay process. The acid and clay dose is approximately one-half of the amount used in the conventional acid/clay treatment process. That is, this process requires only about 2% of 93% sulfuric acid by volume based on oil, compared with 4-6% for the acid/clay process. After treatment with about 0.15 lbs. of the clay per gallon at 300°F and filtration, the lube oil quality is reported to be superior to the acid/clay product, at least in terms of color and color stability, and perhaps viscosity. Although the quantities of acid/clay required in the IFP process are greatly reduced, a disposal problem still exists.

DISTILLATION/HYDROGEN TREATMENT

The distillation/hydrogen treating process is similar to distillation/clay treating, except for the finishing step, shown in Figure 5 (29). Although this scheme is widely used in petroleum refineries, no re-refineries, are using this process; however, two European installations, to be started up in the period 1974-76, are apparently planning to combine hydrogren treating with the IFP propane extraction process previously described.

As described before, a pretreatment section can be used ahead of vacuum distillation to reduce fouling and erosion problems. The distillate (side stream) from the vacuum distillation column is heated using hydrotreating product and an oil fired heater before being mixed with recycle and makeup hydrogen. The hydrogen-oil mixture is contacted with a standard commercial hydrotreating catalyst in a fixed bed. The hydrogen reacts with oxygen and nitrogen containing impurities and unsaturates. The pressure is reduced in two flash drums in series and the recovered gaseous hydrogen is recycled. The purified oil is used to preheat the incoming feed and is then injected into a stripping column where the small amount of volatile materials which may have formed are removed. The purified product leaving the stripper can be used to preheat the vacuum distillation feed before final cooling and storage.


LUBE DISTILLATE
COOLER
FURNACE
H2
CATALYTIC HYDROTREATING REACTOR
TO BLOWDOWN
PURGE
STEAM STRIPPER
STEAM
COOLER
WATER TO PURIFICATION
TO FUEL
LUBE STOCK TO STORAGE
VACUUM DISTILLATION FEED
TO VACUUM DISTILLATION FURNACE

HYDROTREATING

Figure 5

Recent work has shown that the hydrogen treated distillate can match typical properties of 150 viscosity neutral lube blending stock, (30) Hydrotreating conditions were 650 psig, 650°F, 800 standard cubic feet of hydrogen recycled per barrel of feed, and a space velocity of 1.0 vol./vol./hr.

The distillation bottoms which contain almost all of the objectionable impurities can be disposed of as discussed before. However, in conjunction with the distillation/hydrogen treating process development now underway (31), plans are being made for introduction of this high lead material into a secondary lead smelting operation. If this is successful, the distillation/hydrogen treating scheme holds promise of being the first re-refining process without a solid waste disposal problem.

OTHER RE-REFINING APPROACHES

Many proposals for alternative re-refining processes have centered about the possibility of using solvents and/or chemical treating agents. None of these approaches has been commercialized, nor have they reached an advanced state of development.

The use of several chemical flocculants and solvent precipitants such as aluminum chloride, triethanolamine, and trichlorcethylene were studied (32) but showed little promise. A number of non-acid flocculants were investigated as alternatives to sulfuric acid for treating drain oils. Alkanolamines and a diglycolamines were found to be the most effective. (33)

RE-REFINING WASTE PRODUCTS

Re-refining waste products include: acid sludge, caustic sludge, spent clay, pretreatment residues, distillation or extraction bottoms, condenser liquids, scrubber waters, oily waters and low concentrations of air emissions (odors, volatile organics, SO_2, SO_3 etc.).

ACID SLUDGE

Sulfuric acid treating results in reactions with and the dissolving of metal salts, aromatic and asphaltic compounds, organic acids, water, and other polar compounds. A phase separation occurs whereby acid sludge settles and is removed from the treating vessel leaving relatively pure oil behind. The environmental and health and safety aspects of acid sludge are determined by the presence of: sulfuric acid, combustibles, lead, organometalics, sulfonates, calcium, phosphorous, sodium, zinc, other metals and carcinogenic materials. Disposal is obviously a problem. As much as 30-50% of the acid sludge is soluble, complicating land disposal. All acid sludge disposal by U.S. re-refiners is to landfills or lagoons without neutralization. Landfilling of acid sludge is the most common disposal method and appears to be a reasonable method of disposal, provided sufficient safeguards are used to protect personnel, groundwater, and nearby streams. The sludge is often mixed with refuse at the landfill site. The soluble freeacid probably leaches through the soils, but lead, barium, calcium, silver, arsenic, molybdenum, titanium, strontium, and other heavy metal salts may remain in the landfill. The concentrations are low, and should not be a serious problem in a well designed and operated landfill. Work in Germany indicates that acidsludge carefully disposed of does not present serious environmental problems.

The acidity, combustible content, metal content, and possible carcinogen content make it imperative that this waste must not be indiscrimi nately disposed of. Unless suitable air pollution control technology is employed, combustion or incineration of this material, even after neutralization as is done in Europe, is undesirable due to the major amount of sulfur oxides and very fine metal containing particulates which would be emitted. Ocean disposal, now generally prohibited in all but the most extreme cases, is not desirable, although existing data is not negative. Deep well disposal may be suitable in certain instances, but it is expensive, and it is difficult to prove that it is an environmentally sound method.

Lagooning is only a temporary solution. The danger in this type of storage is illustrated by an incident where a re-refiner had his lagoons overflow during a hurricane several years ago, contaminating a nearby river. After lagooning, it is extremely expensive to find a method of disposing of the millions of gallons of sludges stored in this way. Neutralization before disposal appears to be desirable; however, the cost would be significant in this marginal industry.

Acid sludge is generated at the rate of about 10 volumes per 100 volumes raw drain oil, indicating that about 10 million gallons per year of acid sludge is currently being generated. About 10% or more of the oil re-refiners' process oils remain in the sludge.

CAUSTIC SLUDGE

Caustic sludge is generated from emulsion breaking of waste oils. However, only two re-refiners in the U.S. are now known to be using this approach, though waste oil processors may be doing so. The sludge contains caustic, sodium silicate, lead and other metals, and oil. The caustic, lead, other metals, and combustible oils would appear to present environmental health and safety considerations similar to the acid sludge and disposal is equally difficult. Heat may be generated, leaching of metals may occur and personnel are exposed to corrosive materials. Disposal methods are the same as those for acid sludge.

SPENT CLAY

Spent contact clays are generated during the process used to remove acid residues and impurities, and to improve odor and color. The clays themselves contain major portions of silica. Polar compounds are removed by the clay, including oxygen and nitrogen-containing organics. About

0.4 pounds of spent clay are generated for each gallon of re-refined oil produced. The oil content of the clay is estimated to be 20-30%. About 14,000 tons of spent clay are generated per year from re-refining of auto and industrial lubricating oils. An additional unknown quality is generated from industrial oil recycling operations.

Spent clay is ordinarily disposed of to a landfill even though some uses have been found. For example, clay containing oil has been used as a surfacing material for stables and unpaved road stabilization. Although petroleum is expensive on a small scale refineries have regenerated clays by incineration for reuse. Spent clay does not appear to present any significant disposal problem. As an adsorbent, the clay should retain the contaminants. The oil gradually is consumed by bacteria in the soil when clay is disposed of in landfills.

DISTILLATION BOTTOMS

When drain oil is purified by distillation the high boiling non-volatile residue becomes a waste disposal problem. These distillation bottoms are higher in ash, sulfur, nitrogen, oxygen, and acidity content than the lube product. Total ash may reach 10-25%, depending on the extent of pretreatment with lead contents ranging from 5-15%.

Distillation bottoms have been used as an asphalt blending stock. They have been disposed of in landfills and have been stored in lagoons. Distillation and extraction bottoms provide an excellent possibility as a fuel source for secondary lead smelting reverberatory furnaces which are equipped with fine dust collection equipment. Test burning in such a furnace is planned in the near future under an EPA research grant. The geography of such a scheme appears to be good, with many furnaces located across the country (to reprocess batteries). Both fuel and lead values are expected to be recovered.

WASTEWATER

The wastewater from a re-refining plant comes from several sources; water separated from the raw drain oil; cooling water used in indirect heat exchange; cooling water contaminated by direct contact with oil, e.g. in the barometric condenser of a vacuum system; water from condensed stream which contacts oil, e.g. in stream jet vacuum systems, or stripping stream; vent gas scrubbers; and plant runoff water. Both acid/clay and distillation/clay plants are equipped with oil/water separators and neutralization facilities to handle the process water separated from the oil. Vacuum distillations are usually performed with stream jets and barometric condensers, requiring oil/water separation for these effluents as well. Cooling water used indirectly is sometimes provided on a once-through basis with no treatment, sometimes recycled with the aid of a cooling tower, and occasionally joined to other water streams entering an oil/water separator. Some re-refiners also provide for oil/water separators on runoff water.

In the best operations, all direct contact condensers are replaced by indirect air or water cooling; and stream use is minimized by providing efficient mechanical vacuum pumps. Maximum water recycle is practiced with efficient oil separation from the process and runoff waters. Purge water is sent to a municipal sewer plant or trucked to a landfill site. Advanced wastewater treatment systems for "zero" emissions are not now in use.

Little information is available on the analysis of re-refining wastewater. The composition of wastewater will obviously depend upon the type of oil processed, the nature of the re-refining process and of wastewater treatment facilities, housekeeping, the degree of recycle, and other factors. However, one would expect to find traces of the metals which appear in the raw drain oil, in dissolved and suspended solids, dissolved phenols and other organics, and suspended or emulsified oil.

AIR EMISSIONS

A properly controlled re-refining plant will emit very few contaminants to the atmosphere. Early plants contained many open vessels, but few of these are now left. Vents from process and wastewater treatment units and storage tanks in many plants are discharged to a furnace where vented combustible materials are burned. In other plants caustic or ammonia scrubbers are used.

Again little is known about the actual composition of the gases, but some odors are apparent around most re-refining facilities. The odors are no worse and probably somewhat less intense than those encountered around petroleum refineries. Most likely these odors are caused by esters and other organic compounds containing oxygen and nitrogen. Very low concentrations of organic sulfur compounds may also be present, as well as some SO_2 and SO_3 from acid sludge handling.

EUROPEAN PRACTICES (See Appendix B)

Probably the most significant re-refining and recycling movement is that in Germany. The Germans, historically, have re-refined waste oil. Currently, of their 300 million gallons per year lubricating oil requirements, 60 to 80 million gallons are supplied by re-refined oil. This oil competes on the market with virgin oil. The collection of the oil is regulated by law and is supported by a tax on the sale of oil, which is then returned to the re-refiner (or burner of waste oil) who passes on most of the subvention to the collector. Under the law, all waste oil must be collected by a licensed collector. However as in the United States, "do-it-yourselfers" crankcase wastes are probably not collected in Europe. Waste oil is imported into Germany from other countries, refined, and sold back to those countries. The German re-refining industry is basically an acid/clay industry. However, utilization of high-shear mixers and pretreatment with coagulant reduces the amount of acid and clay required. The acid/clay sludges are disposed of in landfills.

The Institut Francais du Petrole (IFP) as previously mentioned has commercialized a propane extraction re-refining process. It is currently being utilized to produce first-rate lubricating oils at the Viscolube plant in Milan, Italy. Two other plants, utilizing the propane extraction process followed by hydrofining, are being built in Yugoslavia and Sardinia by IFP.

OVERALL ASSESSMENT

Acid sludge disposal is the most serious of the re-refining waste disposal problems. Acid sludge persents handling problems which can be overcome with care. Due to its lead, combustibles, and oil content, disposal in lagoons, pits, or by indiscriminate means appears to pose serious hazards. Mixing with refuse and/or neutralization and spreading in well designed and operated landfills experienced in receiving hazardous wastes appears reasonable. Neutralization by mixing with cement kiln tailings, alkaline fly ash, or other alkaline materials is desirable, though not widely practiced. Loss of lead to the land in the quantities now encountered appears to pose no major environmental threat, but obviously is not desirable from the point of view of resource conservation, since U.S. lead supplies are limited. In the long range, it would be very desirable to eliminate the acid treating step which generated this sludge, even though lead content of automotive drain oils will decrease as gasoline lead limitations take effect.

Disposal of spent clay to a well designed landfill does not appear to be a serious problem, although additional data on spent clay composition including the possible presence of carcinogens, and on the rate of oil degradation is very desirable. Other known waste products from re-refining are almost negligible.

In order to ensure long-term protection of the environment from harmful constituents, special consideration of disposal sites should be made. All landfill sites should be selected so as to prevent horizontal and vertical migration of these contaminants to ground or surface waters. In cases where geological considerations may not reasonably ensure this, adequate mechanical precautions (e.g., impervious liners) should be taken to ensure long-term protection of the environment. A program of routine periodic sampling and analysis of leachates is advisable. Where appropriate, the location of hazardous materials disposal sites should be permanently recorded in the appropriate office of legal jurisdiction.

Undesirable air and water emissions from re-refining operations have been reduced considerably in recent years. Additional controls, as necessary, can be instituted if adequate financing and good engineering support are available.

SECTION VII

WASTE OIL REUSE AS A FUEL

Examination of the characteristics of waste oil and its comparison to virgin fuels indicates that the use of waste oil in place of or in conjunction with virgin fuels may create both beneficial and adverse impacts on the environment. For example, the use of waste oil in place of residual oil would reduce such air pollution contaminants as:

- sulfur
- silicon
- sodium
- vanadium
- nickel

Waste oil is also a cleaner burning fuel than coal, generating significantly less particulate emissions. Substituting waste oil for coal would also result in a sharp reduction in the emissions of the above contaminants as well as calcium, iron, magnesium, beryllium, manganese, silver, strontium, aluminum, titanium, boron, and molybdenum.

The potentially adverse environmental impacts of waste oil combustion result from significant concentrations of waste oil contaminants (i.e., as much as 1 percent lead in waste oil), which may be emitted in part to the atmosphere with the flue gas. In addition, these contaminants would be partially deposited out as ash on wall and boiler tube surfaces in commercial, industrial and utility boilers. Currently the most common waste oil fuel applications result in particulate emissions during soot blowing operations, and potentially higher occupational hazards during boiler cleaning.

Table 14 shows that automotive waste oils contain a higher concentration of the following trace elements than are found in virgin fuels:

- magnesium*
- calcium*
- iron*
- lead
- copper
- barium
- zinc
- phosphorus
- silver*
- tin
- chromium

Table 14 also shows the relative presence of these elements if small quantities of waste oil were blended with residual oil and coal.

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*Waste oil contains more of these contaminants than fuel oils but significantly less than coal.

TABLE 14. INFLUENCE OF DILUTION OF WASTE OIL WITH VIRGIN FUELS (34)

	100% WASTE OIL	VIRGIN FUELS		WASTE OIL-RESIDUAL OIL BLEND		WASTE OIL-COAL BLEND	
		100% RESIDUAL OIL	100% COAL	1 WT % WASTE OIL	5 WT % WASTE OIL	1 WT % WASTE OIL	5 WT % WASTE OIL
Gravity API @ 60°F	24.0	13.2		13.3	13.7		
Viscosity, Centistokes	99.0	379		376	365		
Pour Point, °F	-35	52.5		51.6	48.1		
Flash Point, °F	295	210		211	214		
Heating Values, BTU/lb	16,436	18,945	12,486	18,920	13,892	12,526	12,684
BS&W, vol. %	11.0	1.0		1.1	1.5		
Sulfur, wt %	0.43	2.15	2.75	2.13	2.6	2.73	2.63
Ash, wt %	1.01	0.25	10.5	0.27	0.33	10.4	10.1
Magnesium (ppm)	559	14	1,362	20	41	1,354	1,324
Calcium (ppm)	1,850	48	7,768	66	138	7,709	7,412
Iron (ppm)	1,025	120	14,467	129	166	14,333	13,745
Lead (ppm)	6,000	3	71	63	303	138	375
Copper (ppm)	177	1	64	2	9	65	70
Barium (ppm)	1,005	*	258	10	50	265	295
Zinc (ppm)	1,650	*	123	17	85	123	138
Phosphorus (ppm)	1,250	*	30	12	60	42	91
Silver (ppm)	1	0.3	1.7	0.3	0.3	1.7	1.7
Tin (ppm)	58	*	225	0.6	3.0	223	217
Chromium (ppm)	29	13.7	24	13.9	14.5	24.1	24.3

Examination of Table 14 indicates that blending 1 percent by weight of waste oil with coal will not result in any substantial difference in trace element content when compared with unblended coal. A 5 percent by weight blend of waste oil and coal does, however, have a significantly higher lead concentration and, to a less degree, higher phosphorus content than the pure coal. This table also shows that several of the trace elements in waste oil residual/fuel oil blends would be significantly higher than for the unblended residual oil. However, in comparing these higher concentrations with the trace metal content of coal, these waste oil/fuel oil blends are dramatically cleaner except for lead and phosphorus.

MAGNESIUM

As illustrated by Table 14, the magnesium content in waste oil/residual oil blends increases with increasing blend ratios while the magnesium content in waste oil/bituminous coal blends decreases with increasing blend ratios. Magnesium oxide (MgO) is a basic coal ash constituent. It lessens coal fly ash strength and makes boiler cleaning by sootblowing easier. Magnesium in fuel oil also forms a high melting point ash and prevents corrosion. It complexes with corrosive SO_3 gas (35) and is often used as a corrosion inhibiting additive. For bituminous coal blends, the technical impact of magnesium in waste oil is negligible while for residual oil blends it appears to be beneficial.

CALCIUM

The calcium content of waste oil/residual oil blends increases while the content of waste oil/bituminous coal decreases with increasing blend ratios. Calcium oxide (CaO) is a common basic coal ash constituent. When coal contains a large amount of calcium, calcium sulfate ($CaSO_4$) will be created upon combustion. This substance forms very hard deposits that are difficult to remove by water washing. On the other hand, calcium compounds prevent oil ash corrosion by forming high melting point complexes (35).

One reference (36) indicates that based on 100 percent waste oil combustion, 25 percent of the calcium oxidized remains in indirect heating boilers while the balance is emitted to the atmosphere. The manufacture of Portland cement employs direct fired drying kilns. Since calcium makes up roughly 66 percent of the cement, the calcium in waste oil would be of no consequence (34). The technical impact created by calcium from blend ratios of 5 percent or less appears to be minimal. For bituminous coal, the effect of waste oil on calcium content could actually be beneficial.

LEAD

The lead content of both waste oil/residual oil and waste oil/bituminous coal blends appreciably increases with increasing blend ratios.

Many potential users are concerned about the health hazard and increased maintenance cost due to lead deposition on heat exchange surfaces (34). Conflicting observations concerning lead in waste oil and increased boiler tube deposition have been reported. When waste oil is used in place of coal, deposition has remained constant (34). When used with virgin oil, increased deposition has been reported (36, 37).

Due to the high lead content of waste oil, General Portland Cement Company was reluctant to use waste oil as a fuel in their direct fired drying kilns since soluble lead oxide in concentrations as low as 0.001 percent stops cement from setting up (34). This information was contrasted with data from Northern States Power. NSP conducted tests in which a waste oil/coal blend was utilized in a 50 MW boiler equipped with an electrostatic precipitator. NSP normally sells the flyash collected by their precipitator to a Portland cement company as aggregate makeup. The flyash resulting from waste oil combustion contained 230 ppm of lead (normal lead content is 30 ppm when waste oil is not fired). Solubility tests conducted by NSP indicated that only 0.1 ppm of this increased lead content in the flyash was soluble in hot water. It was therefore concluded that this additional lead content would not interfere with the acceptability of this by-product flyash as a makeup material in cement manufacture.

In addition to the above considerations, lead in the ash may also contribute to inefficient boiler operation due to fouling of heat exchange surfaces. From 40 to 97 percent of the lead entering with the waste oil has been reported to remain in the boiler system, either as deposits on heat transfer surfaces or as a part of the bottom ash.

COPPER

The copper content for a 5 percent waste oil/residual oil blend increases twentyfold over the content in the fuel prior to the addition of the waste oil. For waste oil/bituminous coal blends, the copper content does not change greatly with increasing blend ratios up to 5 percent. No technical impacts associated with increased copper content of the fuel has been determined.

BARIUM

As shown by Table 14, the barium content of waste oil/bituminous coal blends increases slightly with increasing blend ratios. The difference between the barium content of virgin bituminous coals and waste oil/bituminous coal blends up to 5 percent is small. Barium causes deposition on boiler heat transfer surfaces (34). Based on 100 percent waste oil combustion testing, 73 percent of the barium in waste oil remains in the boiler while the balance is emitted (36).

ZINC

The zinc content of waste oil/bituminous coal blends increases appreciably with increasing blend ratios. Portland cement manufacturers were concerned about water soluble zinc oxides in their product. This metallic oxide stops the cement from setting (34). The water solubility of the zinc oxide generated upon the combustion of waste oil has not been established in this study. Based on 100 percent waste oil combustion testing, 38 percent of the zinc in waste oil remains in the boiler while the balance is emitted to the atmosphere (36).

PHOSPHORUS

The phosphorus content of waste oil/bituminous coal blends increases notably with increasing waste oil concentration. As in the case of zinc, Portland cement manufacturers fear that this element will also inhibit cement solidification (34). Based on combustion data, 35 percent of the phosphorus is retained in the boiler when firing 100 percent waste oil (36).

OTHER TRACE ELEMENTS

Regarding the other elements shown in Table 14 but not discussed above, no information was found to indicate any direct technical impacts created by these elements during waste oil combustion. In fact waste oil contains significantly less of these materials than is present in bituminous coal.

Because of the widespread concern regarding lead as a hazardous pollutant, the remaining discussion will focus on lead emissions and resulting groundlevel concentrations resulting from these emissions.

LEAD EMISSIONS FROM UNCONTROLLED SOURCES

In estimating lead emissions from a combustion source firing waste oil, three basic pieces of information are required:

- The firing rate of waste oil (gallons/hour)
- The average lead content of the waste oil
- The ratio of lead emitted with the flue gas to the quantity entering with the oil

The firing rate of waste oil is a function of the capacity and operating conditions of a particular combustion source. For example, a large 600-megawatt steam generating power plant consumes about 30,000 gallons per hour of No. 6 residual oil. Based on waste oil supplies, it would be reasonable to assume that such a plant could not fire in excess of 5 percent by weight of waste oil for extended durations. A 5 percent by weight waste oil/fuel oil blend would result in a waste oil firing rate of 1500 gallons/hour. Other proposed and currently practiced applications such as direct firing waste oil in rotary cement kilns, and as a supplementary fuel in smaller boilers generating steam for space heating and process use, consume from a few gallons to several hundred gallons of waste oil per hour.

The lead content of automotive waste oil varies widely, ranging up to 1.0 percent or higher. Waste oil, during the process of handling and storage, may be diluted with other oils and/or solvents but this would only tend to further dilute the lead content. Consequently, an estimate of 1.0 wt. % lead in waste oil is a good conservative value for estimating environmental impacts, as this represent the worst case situation. The current trend towards low lead gasoline may even significantly reduce lead as a significant automotive waste oil contaminant in the future.

The estimation of the ratio of lead emitted from the combustion source with the flue gas to the quantity entering with the oil is difficult to predict as it again is dependent on the combustion system and operating characteristics. For example, the nature and extent of soot blowing operations in a boiler will have a significant impact on lead emissions when firing waste oil. Also the size of the combustion chamber, combustion efficiency, operating temperatures, and chamber geometry will influence the quantity of ash emissions. A summary of available information on lead emissions from a variety of sources has been compiled and is presented in Table 15.

As seen from this table, a significant percentage of lead is emitted with the flue gas during normal operation. It is important to note here that these are emissions estimates upstream of any collection or control system that may be present. One source, Northern State Power Co., in their burning of a blend of 3 parts waste oil to 97 parts coal indicated more than 50% of the lead in the waste oil was emitted. Their estimate was based on an examination of the flyash collected by their electrostatic precipitator as well as evaluation of the lead content of the flue gas down stream of the precipitator. Their flue gas analysis showed no increase in lead content with the use of waste oil, as essentially all the lead-containing ash emitted from the boiler was collected as flyash in the precipitator. A portion of this collected lead-containing flyash, however, was generated during the short soot blowing operation (lasting approximately 5 minutes and performed twice per 8 hour shift), and not during normal operation.

For applications where heat transfer surfaces are not present such as firing waste oil in a rotary kiln or in incinerators, a higher percentage of lead emission is possible. These cases would have to be evaluated on an individual basis to effectively estimate lead emissions. A recent study (40), shows that waste oil can be utilized as an auxiliary fuel in municipal incinerators. Many applications in which direct firing is used, such as rotary kilns, are inherently significant generators of particulate emissions. These processes would therefore require high

TABLE 15. SUMMARY OF AVAILABLE DATA ON QUANTITIES OF LEAD EMITTED WITH FLUE GAS AS A PERCENTAGE OF LEAD ENTERING WITH WASTE OIL FUEL (34)

	DESCRIPTION OF COMBUSTION SOURCE	TYPE OF VIRGIN FUEL	TOTAL FUEL FEED RATE	PERCENTAGE OF WASTE OIL IN FEED	LEAD CONTENT OF WASTE OIL	SOOT BLOWING	LEAD EMITTED WITH FLUE GAS DURING NORMAL OPERATION AS A PERCENTAGE OF LEAD FEED RATE	REE NO
Mobil Oil	Steam Boiler (18,000 lb. steam/hr.)	No. 6 Fuel Oil	147 gal./hr.	5 wt %	1%	yes	50%	37
Shell Oil	Steam Boiler (60,000 lb. steam/hr.)	No. 6 Fuel Oil	374-476 gal./hr.	75 wt %	0.5-1%	no	31%	37
Gulf Oil	Small Home Oil Burner	No. 2 Fuel Oil	3 gal./hr.	25 wt %	1.1%	no	28%	37
Northern States Power Co.	Utility Boiler (500,000 lb. steam/hr.)	Coal	599,360 lbs./hr.	3.1 wt %	0.65%	yes	24-61%*	38
Hawaiian Electric Co.	Utility Boiler (200,000 lb. steam/hr.)	No. 6 Fuel Oil	1,900 gal./hr.	7.5 %	0.45%	yes	25-29%	34
Aberden Proving Ground, Edgewood Arsenal	Steam Boiler (5,000 lb. steam/hr.)	No. 2 Fuel Oil	40 gal./hr.	30%	0.67%	no	3%	39
Esso Research and E Engineering	Steam Boiler (1,000 lb. steam/hr.)	None	7.5 gal./hr.	100%	0.4-0.6%	no	50%	36

* Based on analyses of collected precipitator fly ash which contains ash from soot blowing operations.

efficiency control systems such as scrubbers and baghouses to meet emission requirements. Installations which generally utilize high efficiency collectors are potentially suitable for waste oil combustion. Later this section discusses the impact reductions of lead and other trace waste oil contaminants obtainable with these high efficiency control systems and indicates those industries which utilize such control equipment and which therefore represent attractive potential users of waste oil as a fuel.

Tests were recently performed by Esso Research and Engineering (36) which included the combustion of 100 percent waste oil in a small (50 hp) boiler. The chemical composition and particle size distribution of the resulting particulate emissions were examined and these results reported in Tables 16 and 17.

Table 16. WEIGHT PERCENT OF TRACE CONTAMINANTS IN PARTICULATE EMISSIONS FROM THE COMBUSTION OF WASTE OIL

	Contaminants					
	Pb	Ca	P	Zn	Fe	Ba
range	14 - 19	18 - 13	6.1 - 7.7	3.7 - 5.0	0.9 - 1.3	1.2 - 2.6
average	16	10	6.9	4.3	1.1	1.9

Table 17. PARTICLE SIZE DISTRIBUTION OF LEAD AND OTHER MAJOR CONTAMINANTS IN EMISSIONS FROM WASTE OIL COMBUSTION (units: Wt. percent of the contaminant falling within the indicated particle size range)

	Pb	Ca	P	Zn	Fe	Ba
< 1 micron	76-79	10-19	23-42	56-73	2.7-36	3.3-51
1-10 micron	16-21	71-74	49-66	23-39	51-80	40-79
10 micron	2.7-4.4	10-15	8.9-10	3.4-5.0	13-18	8.9-18

TABLE 18. SUMMARY OF AVAILABLE ESTIMATES AND MEASUREMENTS OF AMBIENT LEAD CONCENTRATIONS RESULTING FROM WASTE OIL COMBUSTION (34)

TEST NO.	COMPANY	LOCATION	APPLICATION	VIRGIN FUEL TYPE	TOTAL FUEL FIRING RATE	WASTE OIL FIRING RATE	LEAD CONTENT IN WASTE OIL (WT%)	STACK HEIGHT (FT)	CONTROL DEVICE UTILIZED	SOOT BLOWER UTILIZED	MEASURED ON CALCULATED MAXIMUM GROUND-LEVEL CONCENTRATION ug/m^3	CONCENTRATION MEASUREMENT CLASSIFICATION	REF. NO.
1	Mobil Oil	Port Mobil, N.Y.	Auxiliary Fuel in Steam Boiler	No. 6 Fuel Oil	100 gal./hr.	5 gal./hr.	1.0	60	None	yes	1.0	Calculated 30 day Average	37
2	Humble Oil	Sewell's Point, Virginia	Auxiliary Fuel in Steam Boiler	None	100 gal./hr.	100 gal./hr.	Unk.	35	None	yes	0.05 0.65*	Measured Short Term Sampler	37
3	Shell Oil	Wood River	Auxiliary Fuel in Steam Boiler	No. 6 Fuel Oil	374-476 gal./hr.	280-360 gal./hr.	0.5-1.0	130	None	yes	0.2	Calculated 30-day Average	37
4	Gulf Research & Development		Domestic Oil Burner	No. 2 Fuel Oil	3 gal./hr.	0.8 gal./hr.	1.1	15	None	no	4	Calculated One Hour Average	37
5	GCA/Technology Division	Northwest U.S.	Auxiliary Fuel in Municipal Incinerator	None	300 gal./hr	300 gal./hr.	1.0	100	None	no	0.05**	Calculated 30-day Average	40
6	Hawaiian Electric	Hawaii	Auxiliary Fuel in Utility Boiler	No. 6 Fuel Oil	1,900 gal./hr.	140 gal./hr.	0.45	137	None	yes	0.11	Calculated One hour Average	34

* Based on ambient sampling during sootblowing.

** Concentration based on a specific act of operating conditions discussed in reference.

GROUND LEVEL LEAD CONCENTRATIONS

At present national ambient air quality standards for lead have not been set and it has been indicated that a previously proposed guideline of 2 micro grams per cubic meter - 3 month average may no longer be sufficient. Consequently, contributions of ambient lead concentrations from sources burning waste oil need to be significantly less than 2 $\mu g/m^3$, averaged over 90 days.

The information available on ground-level lead concentrations from current and projected applications of waste oil combustion, is summarized below in Table 18. Four applications are presented, for utilizing waste oil as a fuel, namely:

- In a domestic oil burner
- In industrial steam boilers
- In utility steam boilers
- As an auxiliary fuel in a municipal incinerator

In all the cases presented, particulate control equipment was not utilized. The estimated ambient air quality could, therefore, in theory be substantially reduced, if control equipment were employed.

In Test No. 4, in Table 18 waste oil is utilized as an auxiliary fuel in a domestic oil burner. Emissions from this test were used to estimate a maximum 1-hour average ground-level concentration of 4 $\mu g/m^3$ This concentration is high. Assuming that 4 $\mu g/m^3$ is representative, domestic heating and similar area source applications (low ground level, densely dispersed) is not desirable unless the lead content in waste oil is greatly reduced.

The tests numbered 1, 2, and 3 are all examples applying waste oil as an auxiliary fuel in industrial steam boilers. Emissions from tests 1 and 3 were utilized to estimate 30-day average ground-level concentrations, and in test No. 2, a short-term ambient sample was collected and its lead content measured. Although the resulting ambient concentrations differed significantly (0.05 - 1.0 $\mu g/m^3$), the data does illustrate that significant quantities of lead are emitted from industrial boilers when firing waste oil up to 360 gallons/hour.

Test No. 5 represents a theoretical estimate of ambient lead concentrations from the use of waste oil as an auxiliary fuel in a municipal incinerator. The maximum ground-level lead concentrations were estimated at 0.05 $\mu g/m^3$. This test is discussed in more detail later in this Section.

Test No. 6 is based on the firing of a 7.5 percent waste oil, 92.5 percent No. 6 residual oil blend in a 56-MW steam-electric utility boiler operating at 36 percent of capacity (20 MW). The 1-hour average maximum ground-level lead concentration was estimated at 0.11 $\mu g/m^3$. The question remains, however, as to the potential impact of utilizing waste oil in a large utility boiler (500 MW) which services heavily populated urban areas. The modeling work discussed below which was performed as part of this study, addresses this specific and important application.

Under contract with the Environmental Protection Agency, GCA Corporation (34) of Bedford, Massachusetts, made estimates of ground-level lead concentrations averaged for two 1-month periods for a large New England power plant (560 megawatts) theoretically firing a 5 percent waste oil, 95 percent No. 6 fuel oil blend. The characteristics of this plant and the fuel oil blend being fired is summarized in Table 19.

The parameters in Table 19 were selected so as to approximate the "worst case" situation for generating adverse lead ambient concentrations. The 5 percent waste oil, 95 percent No. 6 residual oil blend - was chosen as it represents a firing rate of 1500 gallons/hour, which is the estimated maximum rate at which waste oil could be supplied for extended durations. A waste oil lead content of 1.0 percent was selected since previous discussions in this section indicated that this value was at the high end of the spectrum for lead concentrations in waste oil. In addition, since earlier discussions in this section showed that the highest ratio of lead out of the stack to lead entering with the waste oil approximated 50 percent, this value was utilized here. Finally, we choose to estimate average lead concentrations over a 1-month period rather than a 3-month average, since shorter time periods result in higher average concentrations.

Average ground-level concentrations expected over a 1-month period in the vicinity of a selected New England power plant were calculated by means of a Gaussian diffusion model for an elevated point source. Estimates of effective stack height for use in the model were made using an expression developed by Briggs (41). Hourly wind speeds and directions for the calculations were measured at the plant site.

Results of the calculations for 2 months (September and December 1970), presented in Figures 6 and 7 show maximum ground-level concentrations of slightly more than 0.10 and 0.15 $\mu g/m^3$. These maximum values are in good agreement with the value presented in Table 15 for a smaller utility boiler. Consequently, this preliminary environmental impact assessment indicates that an increase in ground-level lead concentrations can be expected if untreated/waste oil is used as a fuel blending component in large utility boilers.

TABLE 19. ASSUMED PHYSCIAL AND OPERATING CHARACTERISTICS OF 560 MEGAWATT POWER PLANT FIRING WASTE OIL (34)

Physical Characteristics

plant capacity: 560 MW

number of stacks: 1

stack height: 300 feet

stack diameter: 18 feet

Operating Characteristics

continuous operator - 7 days per week

type of fuel: 95 wt. percent No. 6 residual oil
5 wt. percent - waste automotive oil

waste oil lead content: 1.0 wt. percent

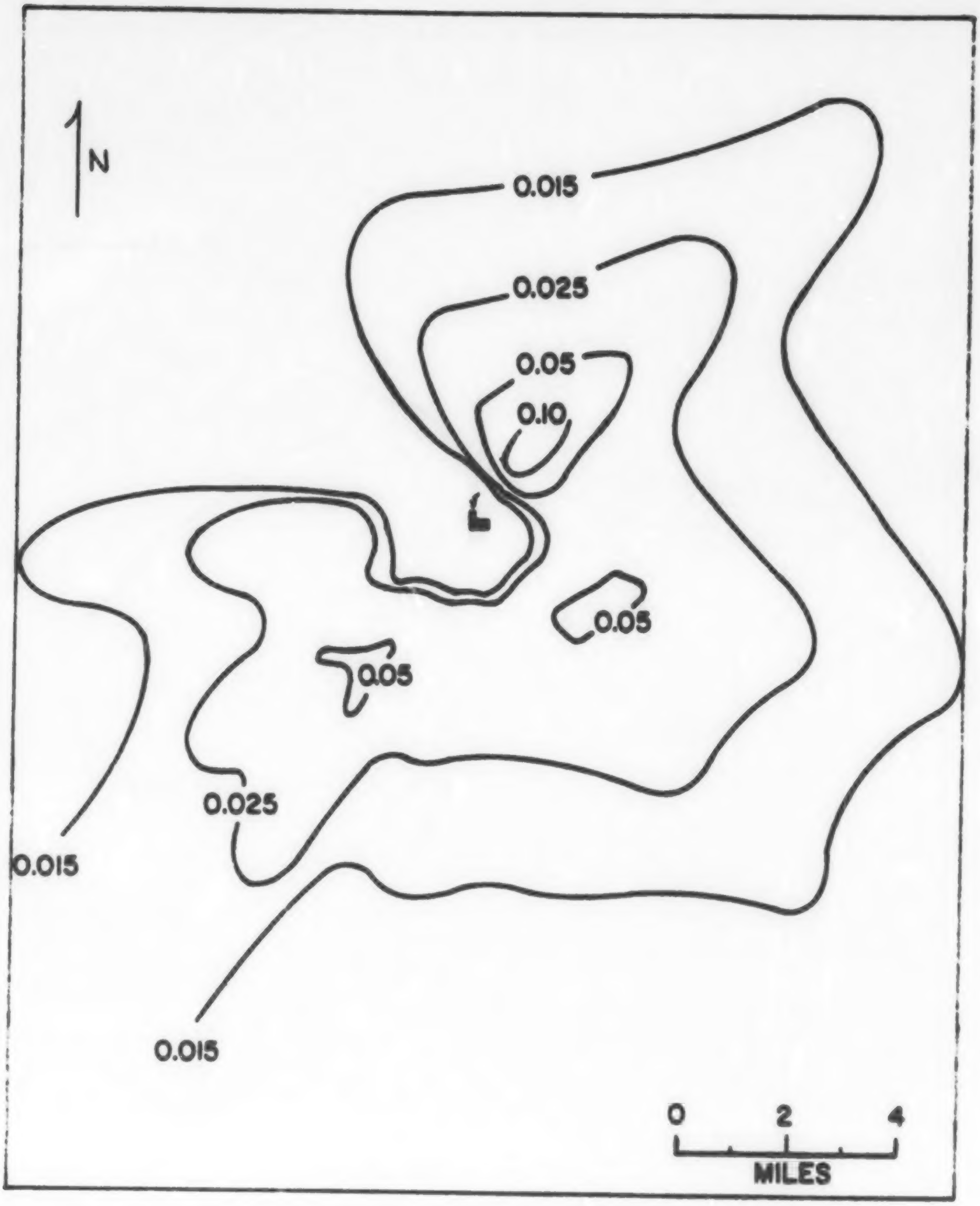
lead emitted with flue gas as a percentage of lead entering with oil: 50%

average fuel feed rate: 17,600 barrels/day = 31,000 gallons/hour

average heat content of fuel blend: 146,000 BTU/gallon

gas exit temperature: 149° C

gas exit velocity: 84.0 feet/second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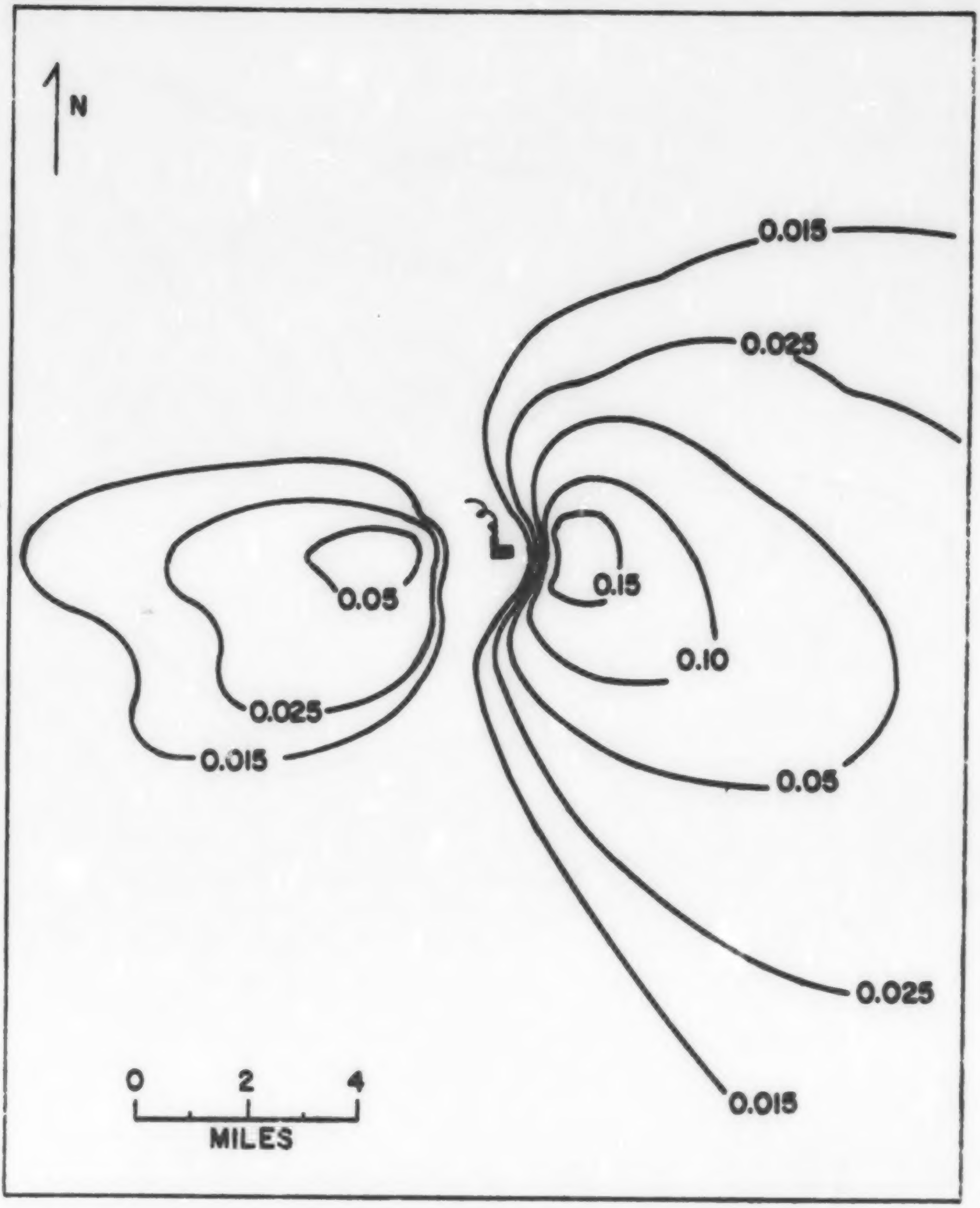
MILES

Figure 6 Isopleths of average ground-level concentration of Pb for September 1970. Units are $\mu g/m^3$. (34)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MILES

Figure 7. Isopleths of average ground-level concentration of Pb for December 1970. Units are $\mu g/m^3$. (34)

GCA (40) also made estimates (Test 5 - Table 18) of average ground-level concentrations in the vicinity of a municipal incinerator using waste oil as an auxiliary fuel over a 3-month period.

The input data are based on a waste oil auxiliary fuel burner system in conjunction with a 400 ton per day municipal incinerator. Exhaust gas were estimated to be 166,000 actual cubic feel per minute (ACFM) based on a typical incinerator excess air level of 200 percent. Using the estimated quantitites of waste oil needed per ton of refuse fired (0.74 gallons/hour/ton/day of incinerator capacity) an estimated 2,250 lbs. per hour of waste oil would be fired. It was assumed that waste oil firing would occur during approximately one-third of the operating time of the incinerator and that the lead content of the waste oil was 1 percent percent by weight. A lead collection efficiency of 50 percent was utilized based on data presented on waste oil burning studies by Mobil Oil Corporation (42). A stack height of 100 feet was assumed although stack heights on many facilities greatly exceed this value.

The ground level concentration calculations are based on the usual Gaussian diffusion model for an elevated source and plume expansion rates specified in Turner's Workbook for Atmospheric Dispersion Estimates (43). Wind data for the model calculations were taken from climatological records obtained over an 18-year period at Falmouth, Massachusetts. The 3-month period used for the calculations was comprised of the three winter months of December, January, and February. The wind data were restricted to the daytime period from 0900-1700 EST, conforming approximately to the daytime period of incineration. For the model calculations, the wind data were expressed as frequency of occurrence of 16 wind direction and 5 wind speed categories. Daytime stability classes from A to D were assigned on the basis of the observed wind speed categories and estimated solar radiation categories. For simplicity, only two effective plume heights were used. The first assumed a plume rise from heat and momentum forces of 75 meters and was used when the surface wind was equal to or less than 6.5 knots. The second assumed a plume rise of 35 meters and was used when the surface wind speed was greater than 6.5 knots. These values were selected as conservative estimates on the basis of trial calculations, using Briggs plume rise formula (44).

The results of the calculations of 3-month average lead ground-level concentrations in $\mu g/m^3$ are presented as concentration isopleths in Figure 8. The calculations assume that waste oil is burned under the conditions stated in Table 20.

Figure 8 shows that the estimated maximum 3-month average ground-level concentration attributable to an incinerator when operating as described above is approximately 0.05 $\mu g/m^3$.

TABLE 20

INCINERATOR INPUT DATA (40)

Incinerator Capacity	400 Tons/day
Exhaust Gas Temperature	500° F
Gas Flow Rate at 500° F	166,000 ACFM
Waste Oil Burning Rate	2250 lbs/hr.
Hours of operation	8 hours/day
Days of operation	5 days/week
Ratio of Waste Oil on Time to Incinerator on time	33%
Lead Content	1% by weight
Lead Collection Efficiency	50%
Stack Height	100 feet

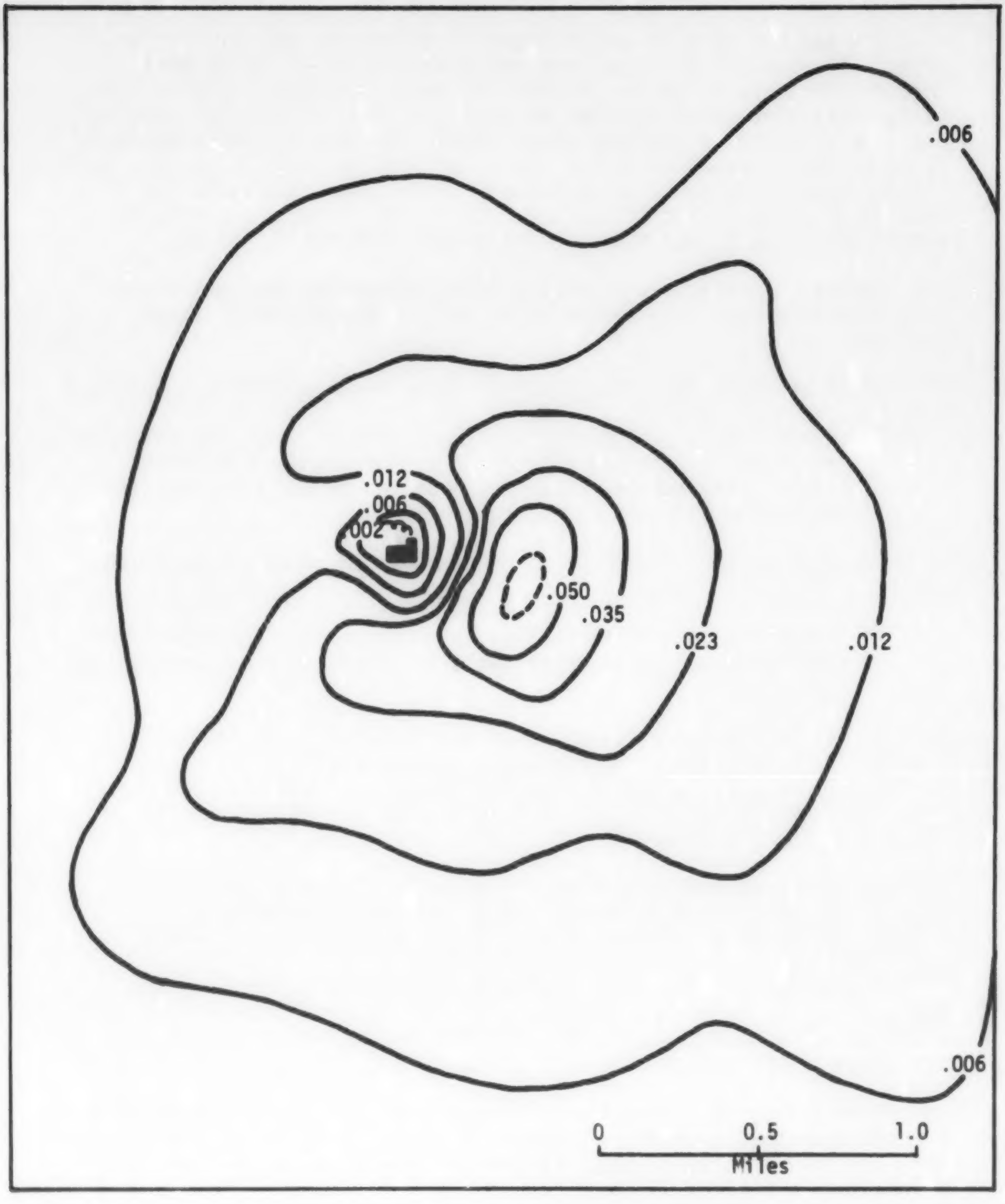
.006
.012
.006
.002
.050
.035
.023
.012
.006
0
0.5
1.0
Miles

Figure 8-Isopleths of average ground-level concentration of Pb for winter season(40). (Units are μg/m^3)

EPA has not established an ambient air quality standard for lead principally because airborne lead can either be directly absorbed through the lungs as people breathe, or can settle out of the air to contaminate dirt which may then be consumed, for example, by children. One type of standard has been established, however, for airborne lead by requiring a reduction in the amount of lead in leaded gasoline. This standard was promulgated on December 6, 1973, under the authority of Section 211, Regulation of Fuels, of the Clean Air Act, in order to reduce preventable lead exposure and protect the public health.

Several alternatives were considered concerning the control of lead emissions from the combustion of waste crankcase oil. These include:

(1) Prohibiting the combustion of waste crankcase oil altogether.

(2) Specifying a safe ambient concentration of lead, and allowing an uncontrolled fuel combustion source to blend untreated waste crankcase oil with virgin oil so as not to exceed the specified safe ambient concentration of lead.

(3) Placing no limitations on the combustion of waste crankcase oil.

(4) Requiring control technology to minimize lead emissions from combustion of waste crankcase oil. This could be accomplished by:

   a. Developing emission standards for stationary source categories which use waste crankcase oil as fuel based on best control (considering cost). These standards would be developed under the authority of Section III of the Clean Air Act.

   b. Recommending burning the waste crankcase oil only in sources which employ highly efficient particulate control systems.

The selection of one of these four options is governed by the Agency's policy established in the gasoline lead additive regulations promulgated on December 6, 1973. The fourth alternative is the only one which is consistent with that policy.

Prohibiting the combustion of waste crankcase oil is a more drastic measure than that adopted on December 6, 1973. That policy requires only that the lead additive content in gasoline be gradually reduced, and tolerates the presence of some lead in the environment. Totally prohibiting the combustion of waste crankcase oil would be in order only if the regulations required immediate elimination of lead as a gasoline additive.

Specifying a safe ambient concentration of lead and allowing waste crankcase oil to be blended with virgin oil to meet the ambient concentration is also inconsistent with the policy established on December 6, 1973. The preamble to the regulations states:

> ...the Administrator determined that it (is) difficult, if not impossible, to establish a precise level of airborne lead as an acceptable basis for a control strategy. ..[The basis for this determination is] that airborne lead can either be directly absorbed through the lungs as people breathe, or can settle out of the air to contaminate dirt which may be consumed by children. Strong evidence exist which supports the view that through these routes airborne lead contributes to excessive lead exposure in ...adults and children. In light of this evidence, the Administrator concluded that it would be prudent to reduce preventable lead exposure. (38 FR 33734)

THe third alternative, placing no limitations on the combustion of waste crankcase oil, is not consistent with the Administrator's conclusions that airborne lead "contributes to excessive lead exposure in .....adults and children.....(and) that it would be prudent to reduce preventable lead exposure."

The fourth alternative, requiring control technology to minimize the lead emissions from combustion of waste crankcase oil, is consistent with the Administrator's conclusion "that it would be prudent to reduce preventable lead exposure."

Even though standards to control lead emissions from burning of waste crankcase oil may be unnecessary due to the effect of removal of lead additives from gasoline on the lead content of the waste oil, we recommend that in the interim between 1975 and 1980 burning of waste crankcase oil be permitted only if lead emissions are minimized to "reduce preventable lead exposure" by burning the waste crankcase oil only in sources which employ highly efficient particulate control systems. In several emission studies conducted by EPA on a variety of lead sources, it was found that baghouses collect lead compounds as efficiently as they collect total particulate. Particle sizing studies by ESSO Research and Engineering on incineration of waste crankcase oil have shown that a large portion of the lead emissions are in the submicron range. A limited number of studies on processes other than combustion of waste crankcase oil have indicated that high efficiently wet scrubbers and electrostatic precipitators effectively remove lead from the effluent gas stream. Due to the high resistivity of some lead compounds, preconditioning of the gas stream may be necessary for efficient collection by electrostatic precipitators. It should also be noted that waste crankcase oil may be used as a fuel if a high-level pretreatment is employed to remove the lead prior to combustion.

REDUCTION OF WASTE OIL FUEL COMBUSTION IMPACTS

The combustion of waste crankcase oil without removal of contaminants can lead to environmental problems, added maintenance of combustion equipment and fouling of boiler and heat exchange surfaces. These problems may run the gamut from significant to insignificant depending upon the quality of the waste oil, whether it is being burned without dilution or whether it is blended in low percentages with other fuel.

The contaminants in waste oil can be classified into three groups:

1. Volatile Contaminants,
2. Soluble Contaminants, and
3. Insoluble Contaminants.

Volatile contaminants are primarily gasoline and water. Gasoline can be present in amounts up to 10 percent. Water ranges from 1 to about 10 percent. The water is present as either free water, emulsified water or oil-soluble water. The free water, but not the emulsified water, can be removed effectively by the usual settling operations. Soluble water is present in trace amounts and is not an important factor in either combustion or processing.

Soluble contaminants include the metal-organic dispersant additives, viscosity index polymeric additives, and other additivies which have been blended with oil and gasoline. These compounds which have remained unmodified through use do not seriously affect the storage, handling and burning of waste oil, although their removal is desirable in terms of alleviating ash deposits on heat transfer surfaces as well as their contribution to ambient emissions. Elements such as zinc, phosphorus and sulfur are present as soluble contaminents.

Insoluble compounds are primarily atmospheric dust, carbon, lead oxide and other metal and metal oxide particulates arising from fuel combustion, degradation of metal organic additives, and corrosion or abrasion of engine parts. The removal of coarse particles is relatively simple but the small particles which remain dispersed by still active detergents and dispersants are not readily removed by conventional solid-liquid separation methods. Unfortunately, most of the harmful metallic constituents in waste oil exist as submicron particles. About 75 percent of the lead oxide particles are submicron in size. Lead is of course the primary constitutent of the waste crankcase oil ash, accounting for roughly 35 percent of the total ash content (36).

Fuel line freezing, burner flameout and variable heating values are all attributable to the presence of water in fuel. Water can be removed to avoid these problems by pretreatment processes. Coarse solids contribute to the abrasive wear of nozzles, pumps, and valves; can plug line and burner strainers; and can lead to excessive sludge buildup in storage tanks. The added maintenance and operating costs incurred as a result of coarse sludge can be eliminated by low level pretreatment, but fine solids are not removed by this pretreatment. These fine particles and the soluble metal organic additives are the principal source of adverse environmental emissions and can cause fouling and corrosion of boiler and heat exchanger surfaces. They can be removed by high level treatment such as vacuum distillation. The property of specific gravity must be considered since stratification can occur during prolonged storage of waste oil blends. This condition can only be corrected by either convective or some other form of mixing of the fuel during storage or by blending just prior to combustion. Pretreatment will not alleviate this stratification tendency except to the extent that specific gravity is changed by the pretreatment process.

Low level pretreatment processes are defined, for purposes of this discussion, as those operations which remove course particulates, water and light ends such as gasoline from waste oil. An adequate low level pretreatment process will allow utilization of waste oil directly, or as a fuel blend, without introducing problems associated with abrasion of valves and atomizing nozzles and burner malfunction due to excessive water or volatile components in the waste oil. Operating and maintenance costs associated with the feed and burner systems should be equivalent to those incurred with conventional fuels. However, the pretreated oil is a high metals fuel, since pretreatment does little to remove metallic constituents and does not significantly alter other effects which can result from waste oil combustion such as fouling of equipment surfaces and the emission of lead and other metallic elements from stack exist gases. Settling is the simplest means of removing that portion of the BS&W not held in suspension by the oil and its dispersants. Although settling is largely ineffective in removing fine contaminants, it does remove coarse grit and free water and is usually the first method employed in any treatment process. More rigorous treatments would involve controlled settling at high temperatures or with a diluent added to reduce oil viscosity.

Other methods of low level pretreatment include centrifugation, filtration, and demulsification followed by settling, centrifugation, or filtration. Demulsification is most successful in removing suspended water; however, it does not remove small particles. Suspended and dissolved water and other volatiles such as gasoline can be most effectively removed by thermal processes which drive off the low boiling contaminants. Flash distillation at atmospheric or reduced pressure is a common technique.

The low level pretreatment processes, discussed above, used in various combinations will produce a fuel oil which can be combusted in conventional fuel burning equipment; however, the fuel oil produced will have a metal's content commensurate with the waste oil which was treated. The removal of these metals would require a high level pretreatment. There are three primary high level processes. These are acid/clay separation, solvent extraction, and vacuum distillation.

These three processes have been discussed under "Re-refining Technology." Other methods or combination of methods could also be used including ultrafiltration, demulsification, electrolytic deposition, and flocculation or coagulation techniques involving for example, a precipitation of gelatinous solids which physically entrap the suspended particulates. None of these latter methods or combination of methods appear commercially suitable at this time for the separation of the many metallic constituents from a product as variable as waste crankcase oil.

Re-refineries using high level treatment processes are interested in the separation of the waste oil into lube oil and other fractions which in the past offered greater return due to their higher market value. However, for processes designed solely for fuel oil production, such fractionation is not necessary and adds unnecessarily to the cost of equipment and its operation. For fuel grade oil production it is only necessary that the process be relatively free of operational problems and that the fuel oil is relatively free of volatiles, metallic constituents, and tarry sediment which could present safety problems, foul equipment, or provide an unfavorable environmental impact in subsequent combustion operations.

In the selection of waste oil treatment processes to reduce the technical and environmental impacts associated with processing and combustion, a decision must be made with regard to the necessity of any treatment at all other than a simple pretreatment process to remove most of the BS&W. If the added maintenance, operational and environmental penalties of waste oil combustion are acceptable as the result of blending and/or through the use of control equipment on stack gases, then no further waste oil treatment may be necessary.

The emission of lead and other contaminants resulting from the combustion of waste oil can be significantly reduced by the employment of high efficiency pollution control equipment. This method of environmental impact reduction is a particularly viable one for those industrial sectors which combine high fuel consumption with a high incidence of high efficiency, particulate control device utilization. These areas are likely potential users of waste oil since they can burn waste oil without significantly increasing air contaminant levels and without incurring cost penalties for extensive pretreatments and the installation of control devices.

Fabric filtration, electrostatic precipitation, and high energy venturi scrubbers are the only control methods which will provide efficient removal of the predominantly submicron sized particles which constitute the bulk of the lead and zinc emissions.

The electric utility industry is by far the largest consumer of fuel oil in the United States. Although control equipment, primarily electrostatic precipitators, is used by this industry they have been applied almost exclusively to coal burning facilities. The particulate emissions from oil burning operations are well below those required by Federal or state ambient air quality standards. Consequently, electrostatic precipitators are not normally installed by plants burning only fuel oil.

In addition to electric utilities, many industrial boilers and processes are equipped with precipitators, fabric baghouses, and high energy venturi scrubbers. Table 21 provides a partial list of industries and indicates the particulate control technology that is used. Table 22 indicates the per annum level of sales of control equipment in the U.S.

In summation, the efficient control of effluent emissions from utilities, industrial boilers, and certain processing operations will allow waste oil fuels to be utilized even in high blend ratios. Control equipment is now used in many industries and waste oil fuel blends could be utilized with low level pretreatment and investment. The installation of control equipment for the specific purpose of reducing waste oil combustion impacts is probably not warranted except for large users; however, as new source standards are promulgated, the use of control equipment will increase and extend the potential for waste oil utilization.

TABLE 21. USE OF PARTICULATE COLLECTORS BY INDUSTRY (34)

MATERIAL CLASSIFICATION	PROCESS	EP	FF	WS
Utilities & Industrial	Coal	+	--	--
	Oil	+	+	--
	Natural Gas	--	--	--
	Lignite	+	--	--
	Wood and Bark	0	--	0
	Bagasse	--	--	--
	Fluid Coke	+	--	--
Pulp and Paper	Kraft	+	--	+
	Soda	+	--	+
	Lime Kiln	--	--	+
	Chemical	--	--	+
	Dissolver tank vents	--	--	--
Rock Products	Cement	+	+	0
	Phosphate	+	+	+
	Gypsum	+	+	+
	Alumina	+	+	0
	Lime	+	0	--
	Bauxite	+	--	--
	Magnes. Oxide	0	--	--
Steel	Blast Furnace	+	--	+
	Open Hearth	+	--	0
	Basic oxygen furnace	+	--	+
	Electric Furnace	0	+	+
	Sintering	+	--	--
	Coke Ovens	+	--	--
	Ore Roasters	+	--	0
	Cupola	0	0	+
	Pyrites roaster	+	--	+
	Taconite	0	--	--
	Hot scarfing	+	--	--
Mining and Metallurgical	Zinc roaster	+	--	--
	Zinc smelter	+	--	--
	Copper roaster	+	--	--
	Copper reverb	+	--	--
	Copper converter	+	--	--
	Lead furnace	--	+	+
	Aluminum	+	--	+
	Elemental Phos.	+	--	--
	Ilmenite	+	--	--
	Titanium dioxide	0	+	--
	Molybdenum	0	--	--
Miscellaneous	Municipal Incineration	0	--	--

+ Most Common, 0 Not Normally Used, EP Electro Static Precipitator, FF Fabric Filter, WS Wet Scrubber

TABLE 22. AIR POLLUTION CONTROL EQUIPMENT SALES IN THE UNITED STATES (34)

(millions of dollars)

	Electrostatic	Type Fabric	Wet	Mechanical	Total
1962	17	8	4	8	37
1963	15	8	5	8	36
1964	20	13	6	12	51
1965	26	16	7	13	62
1966	35	19	11	14	79
1967	36	20	9	12	77
1968	41	29	16	12	98
1969	38	34	16	14	102
1970	62	37	19	15	133
1971	92	56	20	14	182

SECTION VIII

THE EFFECTS OF WASTE CRANKCASE OIL ON SELECTED MARINE AND FRESHWATER ORGANISMS

In response to the 1972 Water Bill, P.L. 92-500, the Environmental Protection Agency undertook research attempting to assess the waste oil disposal problem. Prior to this effort, virtually no information existed on the biological effects of waste oil in the aquatic environment. This report is intended to summarize salient features of this research effort. The report is not intended to replace the specific scientific reports that have or will result from these studies and the reader is urged to consult the individual sources (cited below). It is further emphasized that "waste oils" are part of a generic class of pollutants which are the object of continued study by EPA.

Limited information exists on the disposal of waste oil however, some activities are known which result in the introduction of waste oil into the aquatic environment, these include: road oil use, land disposal, and dumping in sewers. Oil introduced by these mechanisms may occur as a surface slick, emulsified, or as a water soluble fraction. The purpose of this effort was, therefore, to investigate the effects of waste oil as it might be introduced into the environment. This was accomplished by determining toxicity levels and tissue accumulation levels for selected marine and freshwater organisms as well as the chemical characteristics of the oil in its various forms to identify potential toxic components.

TEST RESULTS

Toxicity levels were determined for both marine and freshwater organisms by use of static and flow-through short-term mortality tests known as bioassays. Static bioassays are those in which both the organisms and the toxicant solution are placed in test containers and left for the duration of the test. Flow-through bioassays are those in which fresh toxicant solutions are continuously or periodically added to test containers throughout the test process. In addition, test were conducted with exposures up to 60 days in the marine studies, and over the life cycle of a fish in the freshwater studies. In all of these tests, mortality or disruption of normal function, such as reproduction is the end point criteria. Mortality is then considered as a function of toxicity level and time and is usually expressed as the dose level or time of exposure which kills 50 percent of the species tested.

In freshwater mortality studies, fish were exposed to floating oil, emulsified oil, and a water extract of oil. The level at which 50 percent of the fathead minnows (*Pimephales promelas*) were killed after 96 hours (96-hr LC50) exposure to floating oil was approximately

1.1% oil (11,000 ul oil/liter water or 11,000 ppm). The 96-hr LC50 for the flagfish (Jordanella floridae), exposed to emulsified oil was 0.03790 oil (370 ul oil/liter water or 370 ppm). Flagfish exposed to water extracts of oil resulted in a 96-hr LC50 or 0.38% oil (3,800 ul oil/liter water or 3,800 ppm). Using both species, the 96-hr LC50 for flow-through tests with water extract ranged from 0.1 to 0.16% oil (1,000 to 1,600 ul/liter or 1,000 to 1,600 ppm).

Direct mortality as described above is a crude estimator of toxicity since the effect of exposure may be to alter or upset important normal functions but not produce direct mortality. Thus, chronic, sublethal effect must also be considered.

A test to determine the effects of continuous long-term sublethal exposures of the water extract of a 10 percent oil-water mixture was conducted with the flagfish. This species was chosen for study due to its rapid development from egg to reproductively mature adult. The 120 day test began with the egg stages and was continued through to spawning by the resultant adults (56 days). Changes in survival, growth, and/or reproduction were used to estimate chronic effects. A significant decrease in fry survival and egg production was found at concentrations of 310 ul/liter water and higher. No effects were noted at 80 ul/liter.

One of the factors important in interpreting the results of the waste oil toxicity tests is the chemical analysis of the oil used. This is primarily important in determining what compounds might accumulate in tissues, however, it is also important in determining whether the test oil was representative of an "average" waste oil. Both organic and inorganic components of the waste oil and the freshwater extract of a 10 percent oil in water mixture were chemically analyzed.

Organic components were separated on XAD-2 resin columns into saturated, aromatic, and polar fractions and subsequently characterized in more detail by GC/MS analysis. The oil fraction contained 76 percent saturated hydrocarbons, 4 percent aromatic hydrocarbons, and 4 percent polar compounds. the water fraction, as previously described, contained 80 percent polar compounds, 3 percent saturated compounds, and 14 percent aromatic compounds.

Characterization of inorganic components was conducted by atomic absorption, a technique which permits qualitative and quantitative analysis of metallic elements. Analyses indicate that the major metallic constituents were lead (10,500 mg/liter in the oil and 4.8 mg/liter in the water extract), zinc (1,350 mg/liter in the oil and 16 mg/liter in the water extract), and cadmium (0.4 mg/liter in the water extract). Based on available information, these concentrations approximate the levels commonly found in waste oils throughout the country. It is suspected, however, that most of these metals were not in an ionic form but rather were in organic complexes. How this affects toxicity is not known.

The results of the chemical analysis prompted the investigation of lead, zinc, and cadmium accumulation in fish tissues. Tissues from 30-45 day old fish (J. Floridae) in the chronic test were analyzed for their uptake of waste oil components. Zinc, lead, cadmium, and normal hydrocarbons were found to be concentrated in the tissues in significant amounts.

The short-term toxicity of emulsified waste oil under static conditions was determined for a variety of marine organisms. These included two phytoplankters, two zooplankton species, molluscan and crustacean larvae and a common estuarine fish, the Atlantic silverside (Menidia menidia). The oil was found to be nontoxic to two common species of phytoplankton, Skeletonema costatum and Thalassiosira pseudonana, at levels up to 10 ul/liter. A differential toxicity was noted for the zooplankton species. The 96-hour LC50 for the free swimming oceanic copepod Acartia tonsa was 15 ul/liter whereas, for the bottom dwelling esturaine zooplankton Tigriopis japonicus no effect was seen up to 50 ul/liter.

Molluscan larvae were very sensitive to the oil, with levels of ul/liter affecting coot clam larvae and 4 ul/liter affecting oyster larvae. Also lobster larvae were sensitive, with a 96-hour LC50 of 5 ul/liter. The Atlantic silverside was less sensitive having an acute LC50 of 1,700 ul/liter.

Additional studies indicated that static exposures over longer periods of time, i.e., up to 60 days, resulted in morphological changes in adult M. menidia, oysters, and scallops. The oil was also toxic to scallops at 20 ul/liter after 20 days and to oysters at 100 ul/liter after 36 days.

CONCLUSIONS

Complete information regarding waste oil disposal practices is not available; indications are that discharges resulting in concentrations on the order of 310 ul/liter (310 gallons oil/million gallons water) would not occur except in confined or small bodies of water.

The concentrations used in the various toxicity tests can be employed to make projections of probable effect in natural systems. For example, if it is assumed that a lake of 1,000 acres (43,560,000 ft^2 or 4,047,000 m^2) had an average depth of 10 feet (3.048m), the volume of the lake would be 3,260,000,000 gallons 12,340,000,000 liters). To attain concentrations known to be toxic in freshwater tests i.e., 310 ul/liter, approximately 1,010,000 gallons (3,820,000 liters) of oil would have to be added. As much as 261,000 gallons (988,000 liters) could be added and not exceed the level found to be "safe" to the laboratory, i.e., 80 ul/liter. This is the equivalent of adding 715 gallons (2,700 liters) daily for a year even assuming no degradation or transport of oil out of the lake.

A second example might be the case where the oil is contained in, for example, 1% (10 acres) of the lake. In this case a total release of 10,100 gallons (38,300 liters) of oil or 30 gallons (105 liters) daily for a year would be required to reach the toxic laboratory concentrations of 310 ul/liter. A release of 2,608 gallons (9,870 liters) or 7.7 gallons (27 liters) per day would not exceed the 80 ul/liter level.

The maximum level recommended for emulsified oil in Water Quality Criteria, A Report of the Committee on Water Quality Criteria of the National Academy of Science (in preparation) is 0.05 unit of the 96-hour LC50. A discharge of up to 60,000 gallons (230,000 liters) would not exceed this criterion in the example lake.

Although a "safe" level was not determined in marine studies, the lowest level at which adverse effects were found in acute tests was 1 ul/liter. Utilizing another example, the addition of 3,260 gallons (12,320 liters) of waste oil would be required to reach the 1 ul/liter concentration level in a 1,000 acre estuary averaging 10 feet depth. In this case the addition of approximately 9 gallons (34 liters) would be required daily for a year. This again assumes the unlikely occurrence of no degradation or transport of oil out of the estuary.

Marine organisms appear to be more sensitive to waste oil than freshwater organisms, however large discharges would be required to cause an adverse effect. A spill of 815 gallons (3,085) liters in the example estuary would not cause toxic levels with respect to emulsified concentrations.

Results of the biological studies to date indicate a difference in toxicity among species, among methods of introducing the oil, and between marine and freshwater organisms. However, some of the problems which have not been investigated and could affect our understanding of the effects of waste oil on the environment include the following:

1. Effects on reproductive success of marine organisms.

2. Effects on freshwater invertebrates and more sensitive freshwater fish.

3. Effects on survival and community structure in marine and freshwater field test conditions.

4. Effects on fish flavor impairment.

5. Effects on the sensitivity of organisms to other pollutants or to disease.

6. Synergistic effects of waste oil introduced into domestic treatment facilities.

SECTION IX

ECONOMIC AND LEGAL ASPECTS OF WASTE OIL POLICY

This section of the report addresses the economic and legal factors influencing the disposal and/or reuse of waste oil. The economic analysis presented in the report delineates areas, if any, in the waste oil industry (collectors, re-refiners, and reprocessors of waste oil) where profits are unfavorable, identifies the causes of the poor profits, and discusses different policy options which might effect changes in current conditions.

To facilitate discussion, this section is broken into several subsections: (a) a brief overview of the waste oil problem; (b) waste oil disposal; (c) waste oil collection (d) waste oil re-refining and reclamation.

THE PROBLEM: AN OVERVIEW

The quantities of waste oil generated in both the industrial and automotive areas have been reported in Section III of this report. Due to the great variability of types and quantities of waste generated an economic analysis of the waste oil problem is very complex. The main reasons for this are the current energy crisis, which has made much of the previously reported economic data questionable; and the lack of data with which to quantify environmental damages resulting from waste oil disposal. As previously pointed out the waste oil industry is quite diverse and unstable. It is composed of many small entrepreneurs scattered throughout the United States. This makes it even more difficult to obtain comprehensive operating cost data applicable to the whole industry.

The environmental damages that waste oil can cause are dependent on local-regional conditions, the type of oil, its contaminants, and its concentration. Any disposal alternatives for waste oil must be evaluated with respect to economic efficiency, its effect on other parts of the environment, and must be considered as a component part of total environmental policy. These criteria should be considered in the implementation of any policy options adopted to deal with waste oil disposal and/or reuse.

More specifically: (1) Any costs incurred while reducing the environmental damages of waste oil should be borne by the parties responsible for the degradation. This is a policy consistent with previous Presidential messages on the environment. (2) The interpollutant and intermedia trade-offs resulting from waste oil disposal and/or reclamation (recycling) must be taken into account. A recovery alternative superior under one set of conditions and constraints may not be superior under a different set. In essence, this implies that waste oil disposal should be examined as only one component of total environmental management system. (3) The variation in environmental damages that waste oil can produce in various parts of the country must be recognized in any policy options selected to deal with the issue, i.e., waste oil disposal may be a problem in some sections of the country, but not in others.

ENVIRONMENTAL DAMAGES RESULTING FROM WASTE OIL DISPOSAL *

One of the prime reasons for being concerned about waste oil is the environmental damages which can result from improper disposal. These environmental damages are usually not accounted for in the private decision-making of the firm or individuals responsible for the oils improper disposal, and hence are not reflected in the market place as a cost of doing business.

Environmental damages resulting from waste oil disposal are a function of the amount of waste oil disposed of, the concentration and types of contaminants in the waste oil, the disposal method (direct discharge into waterways, sanitary sewers, or onto land surfaces) and the location of the disposal. It is then necessary to identify threshold quantities of waste oil and contaminant concentrations which will result in environmental damages, and then proceed to economically quantify such damages over relevant contaminant concentration/quantities of waste oil/disposal options. The disposal costs which must be incurred to prevent such damages should be quantified in order to determine an optimal disposal method, or mix of methods, which will maximize net social welfare.

Unfortunately, the necessary data to complete an economic analysis on environmental damages resulting from waste oil disposal (as defined) is lacking. Data on the amount of waste oil being discarded in each disposal option is not of sufficient detail to be useful. Also, there is a paucity of information in the biological-ecological effects resulting from the introduction of waste oil into the freshwater and marine environments. The limited data available is included in Section VIII. Little is known about the toxic and carcinogenic properties of waste oil to humans and the extent to which people may be harmed as a result of groundwater contamination and possible detrimental effects on the food chain resulting from waste oil disposal. In essence, even if adequate information on the number of waste oil spills were available, it would not, in many instances, provide adequate information on potential environmental damages resulting from such spills (64).

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* Waste oil disposal is defined as getting rid of the waste oil in the environment (dumping waste oil into streams, on the ground, open burning, etc.) without any treatment to lessen the potential environmental damages resulting from such dumping, and without any useful benefits (process heat resulting from burning the oil) being derived from such action.

The economic analyses presented are, therefore, based on the best available data on the quantities of waste oil generated, the methods of waste oil disposal and the quantity disposed of in each alternative, and the potential environmental damages resulting from such disposal.

WASTE OIL COLLECTION

About the only thing waste oil collectors have in common is the product they collect, and the fact that the majority of them are small businessmen. After that, all similarities end. For example, in some areas of the Nation, waste oil collectors (or scavengers as they are more popularly called) transport collected waste oil from service stations to re-refiners, or elsewhere for other uses. In other areas, such a service does not exist* and the final disposition of the oil cannot be readily identified. Some industrial users have their waste oil custom re-refined and reprocessed for reuse. Some re-refineries do their own collection of waste oils; however, the bulk of all waste oil collected in the United States is handled by small, independent companies. In most instances contractual agreements do not exist between the collector and the company whose oil he handles (45).

The collection procedures of waste oil scavengers are influenced by economic considerations. When market demand for waste oil is high, the collector will gather the waste oil and sell it at a profit. If the demand for the waste oil is sufficiently high, the collector may be willing to pay the waste oil generator for his oil; however, when the waste oil market wanes, the marginally profitable scavengers are forced out of business, and the remaining collectors are less willing to provide collection services without charging a collection fee (46, 47). Even with a collection fee, some service station operators in Massachusetts experienced difficulty in having waste oil removed on a regular basis due to the economic contraction of the collectors (24).

The collection charges do give the waste oil generator an economic incentive to dispose of his waste oil at place of use in order to avoid the collection costs. Alternatively, the collector who is unable to sell the collected waste oil because of low market demand, has an incentive to dispose of the waste oil the cheapest way possible. Such disposal may include dumping down the sewer, into the nearest waterway, open burning, etc., without regard to the potential environmental damages which may result. Since collectors are not, for the most part, adequately regulated by present laws (46), waste oil can easily be disposed of in an environmentally questionable manner.

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* Such services obviously do not exist where there is not an economic profit or incentive to provide them. Such geographical areas would most likely be characterized by wide geographical dispersion of waste oil collection points and small quantities of oil to be collected at each point.

The general trend in waste oil collection practices over the past decade can be summed up as follows: In the middle 1960's collectors were paying for waste oil; they were charging for collections by 1970; by 1973 the price situation had returned to that of the middle 1960's (45, 46).

Several factors have affected significantly (or will affect significantly) the most recent economic turnabout in the waste oil collection business. (1) The energy crisis has significantly increased the demand for waste oil for use as a fuel oil. An economic analysis of using waste oil as a fuel will be discussed in a separate section. (2) There has been a significant upturn in the "do-it-yourself" oil changes. In the mid-1960's service station, car dealers, and garages accounted for more than 80 percent of automobile lube oil sales (45). It is estimated today that retail sales of lubricating oils at non-service station outlets (over-the-counter retail sales) is between 25 and 45 percent. It is obvious that as services and supplies of drain oil become less concentrated, the costs of collections will increase. (3) The energy crisis will probably affect the generation of waste automotive lubricating oil. As gasoline becomes harder to obtain, automobile owners and drivers will do less driving. This should precipitate a downturn in the frequency with which crankcase oil is changed. (4) Increases in the recommended interval between crankcase oil changes by the major car manufacturer has also helped decrease the available supply of waste oil. (3) These four factors working together logically, will, not only affect the supply of waste oil, but also increase the collection costs as more effort has to be expended to collect the same quantity of waste oil.

Table 23 presents the potential profits and losses to waste oil collectors (over different size tank trucks) who sell their oil as road oil, as re-refinery feed stock, or as a fuel. The profitability of waste oil collection is influenced by many items. *

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* It should be emphasized that the energy crisis made it very difficult to perform an economic analysis. Unless indicated otherwise, Tables 23 - 52 present the best estimate of national conditions existing in the industry during December 1973; hence, this economic analysis should be viewed as applicable only to the very short run. As evidenced by the data, the industry is in a dramatic state of change. Because of the energy crisis, and its resulting effect upon cost/price/profit conditions, the long-run economic status of the industry could not be estimated at this time. The profit (loss) ranges present the worst and best cost/price/profit figures which available information indicates as being relevant for the nation. The actual cost/price/profit distribution of the firms within the ranges are not known; however, it is expected that most firms will be concentrated about the center of the ranges.

Table 23

WASTE OIL COLLECTORS: ESTIMATED PROFIT AND (LOSSES) PER ACTIVITY

TANK STORAGE CAPACITY (GALLONS)	AVERAGE TRANSPORTATION COSTS PER GALLON	CHARGE (COST) OF WASTE OIL COLLECTED PER GALLON	ESTIMATED PROFITS (LOSSES) IN CENTS/GALLON		
			Road Oiling 1/	Re-refineries 2/	Non-Treated Fuel Oil 3/
2,000	15	4 - (3)	(8) - 4	(12) -1	(10) - (2)
2,000	9	4 - (3)	(2) - 10	(6) - 7	(4) - 4
4,000	6	4 - (3)	1 - 13	(3) - 10	(1) - 7
6,500	4	4 - (3)	3 - 15	(1) - 12	1 - 9

1/ The first row of profit figures for a 2,000 gallon tank are developed in the following manner: (a) Total costs of picking up waste oil--11¢ to 18¢ per gallon of waste oil, figured as follows: 15¢ per gallon transportation cost plus 3¢ per gallon paid to waste generator = 18¢; 15¢ per gallon 3¢ per gallon transportation cost plus 3¢ per gallon paid to waste generator = 18¢; 15¢ per gallon transportation minus 4¢ per gallon waste oil collector is paid to collect oil = 11¢; (b) Gross return on road oiling is between 10¢ and 15¢ per gallon. Ten cents gross return minus 18¢ total cost = 8¢ loss; 15¢ gross return minus 11¢ total cost = 4¢ net profit. The rest of the profit (loss) situations are calculated in a similar manner.

2/ The profit (loss) ranges are calculated in the same manner as they are in footnote number 1. The gross return on sales to rerefineries vary between 6¢ to 12¢ per gallon of raw waste oil.

3/ The profit (loss) ranges are calculated in the same manner as in footnote number 1. The gross return on sales of waste oil as untreated fuel oil ranges between 8¢ and 9¢ per gallon.

The maximum range for waste oil collection in the United States is between 100 to 250 miles in size (48). The variables influencing the profitability of the waste oil collectors and the size of the collection districts are as follows: (1) the concentration of waste oil collection sites within a collection district; (2) the quantities of waste oil available for collection at each site; (3) frequency of collection; (4) fluctuation in the availability (supply) of waste oil over some specific time period (one year, for example); (5) the type and quality of waste oil to be collected; (6) operating constraints placed upon the collectors by governmental authorities (environmental constraints for example); (7) the efficiency of the waste oil collector in managing the system.

Nationally there is a wide range of collection costs for waste oil. In some areas, the western part of the United States particularly, service stations and garages have paid up to four cents per gallon to have waste drain oil removed, with two cents per gallon being cited for "clean oil close in." In the Midwest, the collector may (1) charge from 1.0¢ to 1.6¢ per gallon to pick up the waste oil; (2) be given the waste oil by the generator in exchange for picking up the oil; or (3) be paying as high as 3¢ per gallon for top quality crankcase waste. On the East Coast waste oil collectors have been charging up to 3¢ per gallon for waste oil pickup. This charge has been attributed to the fuel shortage, and the resulting competition among collectors for waste oil supplies to be blended into lower grades of fuel oil (48). Nationally then, waste oil collectors may charge as high as 4¢ per gallon to pickup waste oil in some parts of the country to, alternatively, in other parts of the nation paying the generator of the waste oil 3¢ per gallon.

What waste oil collectors can then charge for their waste oil is dependent upon the uses to which it will be put. For example, road oiling operations can return (gross) between 10¢ and 13¢ per gallon of raw waste oil (48). As of December 1973, untreated waste oil sold as a fuel oil would gross between 8¢ and 9¢ per gallon. Re-refineries were paying anywhere from 6¢ to 12¢ per gallon as of December 1973 for deliveries of waste oil (32).

Based upon an updating of recent figures on motor vehicle expenses, the costs of operating an inter-city truck are about $1.44 per mile (34). This figure includes not only the operating expenses of the truck, but also the depreciation of the terminal facilities and overhead. While this figure may be somewhat high for trucks operated by independent waste oil collectors,* it does not give a good approximation on operating costs.

From (48) and in ** it was learned that the radius of waste oil collection districts range in size from 100 to 250 miles. If a round trip per tanker truck of 200 miles is assumed, then a rough order approximation can be obtained on what it costs to transport waste oil in different size tank trucks. This can be seen in Table 23, where the first column represents the net hauling capacity of different size trucks.*** The second column presents the estimated transportation costs per gallon of waste oil.****

The table illustrates several concepts. Based on the assumption that all tank trucks are filled to capacity at the end of the 200 mile collection trip, the costs of transporting the waste oil per given mile decrease as tankage size increases (i.e., the concept of economies of scale). Road oiling appears to give the highest return to collectors (8¢ maximum potential loss* per gallon to 15¢ maximum gross return per gallon). The overall return from selling the waste oil as a fuel oil (10¢ maximum potential loss to 9¢ maximum potential profit per gallon) is higher than selling the oil to re-refiners (12¢ maximum potential loss to 12¢ overall profit).

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* The reasons for this are as follows: (1) Most of the independent waste oil collection trucks are owner-operated. The rate of return on invested capital can be appreciably lower in such instances than if the entrepreneur had to pay union wages. (2) Employee supervision and related expenses are foregone in many owner operated businesses. Maintenance and repair expenses on the collections truck are probably less expensive, because the owner-operator in most instances, will do a good share of this work. Depreciation, maintenance, and overhead costs associated with terminal facilities will probably be less, because the owner-operator will have minimal facilities of this nature, or none at all.

**Conversation with Mr. William Penn (one of the authors of ref. 48) on March 29, 1974.

*** The criteria for selecting the different tank sizes are as follows: (1) the 2800 gallon tank is in common usage for collection of waste materials from local sources, and is relatively easy to handle in tight congested places (60); (2) a 4000 gallon tank size was chosen because it was mentioned as being the tank size used for father-son operations (45); (3) the 2000-6500 gallon tank sizes were arbitrarily selected. The net tankage capacity of 6500 gallons represents about the largest tankage capacity based on weight limitations (approximately 73,000 lbs. maximum gross weight for a loaded tractor and semi-tractors); 25,000 lbs. base weight tractor-trailer; average weight of waste oil 7.5 lbs. per gallon) on interstate highways.

**** These charges are arrived at as follows: $1.46 per inter-city mile x 200 miles = $292.00 cost per trip; $292.00 ÷ net tank size = transportation costs per gallon.

As previously mentioned, the bulk of all waste oil collected in the United States is handled by small, independent companies. There are normally no contractual agreements between collectors and the companies whose oil they handle (45). The whole collection system for waste oil is rather tenuous. Sources of supply for re-refiners or other waste oil processors are not guaranteed. This, together with other complicating circumstances, has resulted in some re-refiners running at less than designed capacity, effecting in increased costs per unit of output.**

Some re-refiners have attempted to obtain some guarantee of feedstocks by operating their own waste oil collection services. Re-refiners who can do this appear to enjoy a more stable feedstock supply than do re-refiners who are dependent entirely on independent collectors for waste oil delivery (45).

The delivered cost of feedstock for re-refiners who do their own collection is higher than if they bought directly from an independent. The reasons for this have been previously detailed above (owner-driver operated truck, lower maintenance and overhead costs, etc.).

Pipelines and barges are transportation alternatives to the trucking of waste oil. With the low volumes of waste oil that usually must be disposed of, and the long distances often involved in its collection and transport, it is highly unlikely that either of these two alternatives would be widely accepted as being economically competitive with trucking. The same would be true for railroad tank cars, except in a closed loop arrangement that a producer-reuser of waste oil may have with a re-refiner. Here the volume of waste oil to be reprocessed and reused by the same producer must be commensurate with truck car sizes.

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* Obviously, the waste oil collector would not continue to sell his collected waste oil at a loss for very long. However, these figures are an approximation of the firm's maximum loss in the short run.

** These would include, among others, the Federal Trade Commission labeling requirements, the Internal Revenue Service's interpretation of the Excise Tax Reduction Act of 1965, and antiquated plant equipment.

WASTE OIL RE-REFINING AND RECYCLING

As has been previously noted, in 1960 there were between 125 and 150 re-refiners in operation. At present, the number of firms in the re-refining business is now around 40 (6,45) and the re-refining capacity has dropped from approximately 300 million gallons of capacity in 1960 to around 100 million gallons by 1972 (45). It would appear that the economic contraction which has characterized the industry over the last decade has, for the moment at least, leveled off.

A number of factors have been identified as contributing to the decline of the re-refining industry.

1. The volume of waste oil available for re-refining has declined in certain geographical areas. There has been increased competition for the waste oil in alternative uses (use as a fuel oil or road oil), which has provided a higher return to the waste oil collector (as explained previously). This has resulted in the re-refiner having to pay higher prices for delivered waste oil feedstock, and also has sharply curtailed the volume of feedstock available for re-refining. Because of the unfavorable stigma attached to his product, and because of increased competition from cheaper brands of virgin oils, the re-refiner has been unable to readily, in the past at least, pass these increased costs on.

2. Many re-refining plants are 30 years old or older, and cannot be modernized to be more efficient (45) or to meet new pollution standards and constraints without a large amount of new investment. The rate of return on capital has not been high enough to attract new investment for plant modernizations.

3. The re-refiner probably has been placed at a competitive disadvantage by the 1964 Federal Trade Commission (F.T.C.) ruling that oils sold in interstate commerce which are compounded in whole or in part of preious used oils must be labelled as "manufactured from previously used oils" (45). Detailed information on this ruling are included in Appendix D. The prime reason for such a ruling was that the industry's reputation has been blemished by the questionable integrity of some operators who have not produced high quality products. Particularly tarnished have been those re-refiners producing a high quality lube product. The stigma has probably been further perpetuated by the FTC ruling, since to a potential customer the word "used" would tend to imply an inferior product. However, it should be mentioned that the FTC is considering the advisability of revising its regulations in this area at the present time.

4. The interpretation of the Excise Tax Reduction Act of 1965 by the Internal Revenue Service (IRS) removed an excise tax advantage which re-refiners have enjoyed on sales of lube oil for off-highway use. A subsequent ruling by the IRS concerning the payment of the excise tax on virgin oil which is blended with re-refined products sold off-highway use further weakened the re-refiners competitive position. Details on these

rulings are included in Appendix E. In essence, the re-refiners have to pay a non-refundable tax of six cents per gallon on virgin oils which are blended with re-refined oils and are subsequently sold for off-highway use whereas taxes on lubes composed completely of virgin oil and used off-highways are refundable.

The economic impact on the industry resulting from the FTC-IRS rulings is difficult to determine. However, in line with the Agency's policy to encourage recycling of recoverable materials, the IRS ruling 68-108 should be reversed to permit the non-highway user of re-refined oil to obtain refunds of taxes paid on virgin oils blended with the re-refined lube.

The economic contraction of the waste oil industry over the past decade appears not to have been without its benefits (51). The industry is probably healthier and stronger than at any time within the past decade. The reasons for this can be characterized as follows. The firms which would go out of business because of economic inefficiencies and/or environmental constraints have, for the most part, already done so. The re-refining plants in operation today represents a substantial investment in environmental quality control systems. The surviving entrepreneurs, while they are not getting rich, are enduring; i.e., the re-refining industry is viable.

The successful re-refiners who have survived the past decade have had the following characteristics.

1. The re-refining plants are located within geographical areas having sufficient concentration and quantities of waste oil.

2. The re-refiners do not have stiff competition from waste oil used in alternative uses.

3. An established, readily definable market for the re-refiner's oil exists; i.e., industries are willing to contract for waste oil re-refined to their specifications (48).

4. The re-refiner has an established, quality product (48).

5. The re-refiner has contracts with an independent waste oil collector, or is undertaking other steps to assure a continuous waste oil supply. Re-refiners who have such contracts or who do their own collection, enjoy a more stable position regarding feedstock supply (45).

An economic analysis of the re-refining industry is not an easy undertaking. Each re-refining plant is built to produce a specific product or mix of products. The costs of operation and the revenues received for products produced and sold by each plant vary across the Nation. For example, the cost of water varies from 66¢ per thousand gallons for one re-refiner in the Midwest to as little as 3¢ per thousand gallons for a re-refiner on the West Coast. The difficulty of the situation has been further compounded by the current energy crisis. The price of delivered waste oil feedstocks to the re-refiners has gone up approximately 200% to 400% from July 1973 to December 1973. The prices that re-refiners received for their unblended, re-refined lube stock have doubled during the same time period.

Table 24 presents an economic comparison of four re-refining methods. This table has been adapted from two EPA contract reports (6, 45). The cited sources present cost/revenue data applicable to July 1973. Relevant cost/price indices and conversations with industry sources have been used to update these data to December 1973. The assumptions underlying the development of this table and the subsequent economic analysis are as follows:

1. The plant capacities for each re-refining process are assumed to be five million gallons of raw waste crankcase oil per year. The plants are assumed to operate 24 hours per day, five days per week, 50 weeks per year. This particular mode of operation allows repair and maintenance on weekends when necessary. It is the type of operation most common in the industry.

Under normal operating circumstances, a five million gallon plant is about the smallest plant size that can remain economically viable (6). An economic analysis of plants this size will establish minimum levels of profitability. One would expect profit levels to increase with larger plant sizes because of the economies of the scale involved.

2. Product quality is assumed the same for each process. Insufficient data is available to properly examine the validity of this statement.

3. The cost/price/profit data presented in the tables are what an entrepreneur going into the re-refining business could anticipate from each re-refining technology at least in the short run. This permits a comparison on the profitability of each process technology.

4. The process yields for each technological process are optimisitc when compared to existing re-refiners; however, the yields are obtainable with some feedstocks and careful operation. The data presented in Table 24 present the profit/cost potential for a well-run, efficient plant.

5. The economic analysis on re-refining in this report concerns itself only with the re-refining of waste crankcase oils to lube oil quality. The reasons for this limitation are as follows. Waste crankcase oils are found to be more uniform than industrial waste oils. There is a greater spectrum of virgin oils used in industrial processes as compared to automotive uses. Hence, those regions having proportionately more industrial concentrations will have more broadly varying waste oil types. Because of this composition problem with waste industrial oils, it is extremely, difficult to derive the economics for a representative plant. However, most industrial waste oil re-refining processes are cheaper than the reprocessing waste crankcase oils to unblended lube stock (52).

TABLE 24. CRANKCASE WASTE OIL PROCESSES (6)

Process	Primary Product	Primary Wastes & By-products	Investment (in dollars)	Op. Cost (cents per gallons)	Comments
Acid/Clay	Lube blending stock	Acid sludge, spent clay	1,176,000	26.52-34.86	Widely used in U.S.
Extraction/ Acid/Clay	Lube blending stock	Acid sludge, spent clay; high ash fuel by-product	1,391,000	22.65-29.80	One Operating plant in Italy
Distillation/ Clay	Lube blending stock	Spent clay; high ash fuel by-product	1,195,000	21.64-29.54	At least two plants in U.S.
Distillation/ H_2 Treating	Lube blending stock	High ash fuel by-product	1,368,000	23.31-31.21	Under development

Includes 10% per year depreciation, but excludes return on investment.

Table adapted from Ref. (6); All Costs Revised to December 1973.

Table 24 presents an overview on investment and operating costs for four waste oil-refining technologies. Table 25 provides the supporting data for the investment costs appearing in Table 24. Tables 26 and 27 show the derivation of the operating costs shown in Table 24. Table 27 also presents the potential profit and percent return on investment from selling unblended lube stock.

More specifically Tables 24 and 25 show that the extraction/acid/clay process has the highest initial investment. Table 24 presents operating cost data showing the distillation/clay process having the lowest relevant range of operating costs. The acid/clay process has the lowest investment cost and the highest range of operating costs. The other two re-refining processes lie between these two extremes.

Table 26 presents the operating costs (exclusive of raw waste oil feed costs) for each process technology. In all processes it can be seen that direct and indirect labor costs contribute the most to the unit costs. Chemicals contribute quite heavily to the total operating costs in the acid/clay process. Waste disposal costs are minimal under all processes. The analysis shows that the acid/clay process has the highest operating costs (18.19¢ per gallon of finished product), while the distillation/clay process has the lowest costs at 13.75¢ per gallon on unblended lube stock. The input costs of the raw waste oil are excluded from these figures.

In Table 27 the input feed costs of raw waste oil are added to the operating costs to obtain the total costs of processing raw waste oil to unblended lube oil. As one can see, the delivered costs of waste oil vary considerably, and hence, impart a wide range to the total costs of operation.

Unblended lube stock sells from 38¢ to 44¢ per gallon. High as fuel oil (derived as a joint product with lube stock) sells between 8¢ and 20¢ per gallon. Given these processes, a profit of 3.14 to 17.48¢ per unit of finished product can be realized with the acid/clay process, while 9.01¢ to 23.74¢ per gallon of finished produce can be realized with the distillation/clay processes; or, alternatively, a return of investment of 9.61% to 53.51% for the acid/clay process, or 28.65% to 75.49% for the distillation/clay process. Again, one must remember that the wide range in the costs and rates of return reflect the different cost/revenue patterns which re-refineries face nationwide. The costs developed for these processes do not include transportation costs and other related expenses which might be incurred while getting the re-refined waste crankcase oil to the buyer. To the extent such costs have not been taken into account, the net profit ranges associated with each market and process technology will be overstated.

Most re-refined oils are sold to independent jobbers in unblended bulk lost (more than 2,000 gallons). The jobbers pack the oil in 55 gallon drums or quart cans, and sell it to commercial accounts, garages, independent (as opposed to major brand) gasoline stations, automobile supply stores and discount houses.

TABLE 25. CRANKCASE WASTE OIL PROCESSING CAPITAL INVESTMENT (6)

Basis: 5 Million Gal/Yr. Raw Oil; 250 Days/Yr. Operation

Process Product	Acid/Clay Lube	Extr/Acid/Clay Lube	Dist/Clay Lube	Dist/H Lube
Investment 1/ $1000				
Process Equip. 2/	676	847	821	789
Storage Facil. 3/	373	409	447	447
Office & Lab. 4/	33	33	33	33
	1082	1289	1101	1269
Land & Site 4/ Improvement	94	102	94	99
	1176	1391	1195	1368

1/ All Costs Revised to December 1973.

2/ All costs adjusted by composite wholesale price indexes for machinery and equipment to reflect costs as of December 1973. (53)

3/ Assumed to be storage tanks. Costs adjusted to December 1973 using wholesale price index for oil storage tanks at 10,000 barrel capacity. (61,62)

4/ Adjusted by the Department of Commerce Composite Construction Index to November 1973. (53)

TABLE 26

CRANK CASE RE-REFINING PROCESS OPERATING COSTS 1/
(BASIS: 5 MILLION GAL/YR RAW OIL: 250 DAYS/YR OPERATION)

Process	**Acid/Clay**		**Extr./Acid/Clay**		**Dist./Clay**		**Dist. H_2**	
Product - Main Type	Lube Oil		Lube Oil		Lube Oil		Lube Oil	
Yearly Prod.	3.6×10^6 Gal.		4.2×10^6 Gal.		3.8×10^6 Gal.		3.8×10^6 Gal.	
Yield	72%		84%		76%		76%	
Investment $1000								
Plant (P)	1082		1289		1101		1265	
Land & Site	94		102		94		99	
	1176		1391		1195		1368	
Chemicals	Basis 2/	¢/Gal.	Basis	¢/Gal.	Basis	¢/Gal.	Basis	¢/Gal.
93% H_2SO_4 @3¢/Lb.	1.06	3.18	0.36	1.08	-	-	-	-
Clay @ 3.37¢/Lb. 3/	0.4	1.35	0.15	0.51	.125	0.42	-	-
H_2 @ 0.41¢/SCF 4/	-	-	-	-	-	-	3.6	1.47
Propane @ 2.08¢/Lb. 5/	-	-	0.03	0.06	-	-	-	-
Other 6/	-	-	-	-	-	0.41	-	0.27
Utilities								
Electric Power @ 3.15¢/KWH 7/	0.1	0.32	0.3	0.95	0.2	0.63	0.2	0.63
Water @ 5.40¢/1000 Gal. 8/	0.017	0.09	0.04	0.22	0.021	0.12	0.2	0.11
No. 6 Fuel Oil @ 18.96¢/Gal. 9/	-	-	0.037	0.70	-	-	-	-
Plant Labor								
Wages @ $11,336/Yr. 10/	8 men	2.52	8 men	2.16	8 men	2.39	8 men	2.39
Supplies & OH @ 50%	-	1.26	-	1.08	-	1.20	-	1.20
Maintenance (5% of plant/yr)	-	1.50	-	1.53	-	1.45	-	1.67
Ins. & Local Taxes								
@ 3% Invest/Yr.	-	0.98	-	0.99	-	0.94	-	1.08
Waste Disposal 8/	-	0.54	-	0.22	-	0.03	-	-
Depreciation								
@ 10% P/Yr.	-	3.01	-	3.07	-	2.90	-	3.34
Indirect Costs 10/								
Salaries @ $82,400 per year	-	2.29	-	1.96	-	2.17	-	2.17
Suppl. & OH @ 50%	-	1.15	-	0.98	-	1.09	-	1.09
Oper. Cost (excluding feed)		18.19		15.51		13.75		15.42

FOOTNOTES TO TABLE 26 -- CRANKCASE WASTE OIL PROCESS OPERATING COSTS

1/ Table adapted from Ref. (6): all costs revised to December 1973.

2/ Amount of material required per gallon of finished lube oil.

3/ Adjusted by the wholesale price index for nonmetallic mineral products to December 1973 (53).

4/ Adjusted by the wholesale price index for industrial chemicals to December 1973 (53).

5/ Adjusted by the wholesale price index for propane to December 1973 (61, 62).

6/ Adjusted by the wholesale price index for industrial chemicals to December 1973 (53).

7/ Adjusted by the wholesale price index for electric power to December 1973 (53).

8/ Adjusted by the wholesale price index for all commodities to December 1973 (53).

9/ Adjusted by the wholesale price index for residual fuels to December 1973 (61, 62).

10/ Adjusted by an index of average earnings to December 1973 (53).

TABLE 27. POTENTIAL PROFITABILITY OF CRANKCASE WASTE OIL PROCESSES UNBLENDED BULK SALES[1]

(All costs and revenues in cents per gallon)

Process	Acid/Clay	Extr./Acid/Clay	Dist./Clay	Dist./H_2
Product	Lube Oil	Lube Oil	Lube Oil	Lube Oil
Investment, $1000	1176	1391	1195	1368
Oper. Costs excluding feed (per unit of product)	18.19	15.51	13.75	15.42
Feed Costs @ 6-12¢/Gal. of Raw Oil	8.33 - 16.67	7.14 - 14.29	7.89 - 15.79	7.89 - 15.79
Total Costs of Operation	26.52 - 34.86	22.65 - 29.80	21.64 - 29.54	23.31 - 31.21
Product Credits[2]				
Lube Stock @ 38-44¢/Gal.	38.00 - 44.00	38.00 - 44.00	38.00 - 44.00	38.00 - 44.00
High Ash Fuel Oil @ 8-20¢/Gal.[3]	-	0.59 - 1.48	0.55 - 1.38	0.55 - 1.38
Total Product Credits	38.00 - 44.00	38.59 - 45.48	38.55 - 45.38	38.55 - 45.38
Profit (Loss) Before Tax Per Unit Product	3.14 - 17.48	8.79 - 22.83	9.01 - 23.74	7.34 - 22.07
$/Yr.	113,040 - 629,280	369,180 - 958,860	342,380 - 902,120	278,920 - 838,660
%/Yr. Return	9.61 - 53.51	26.54 - 68.93	28.65 - 75.49	20.39 - 61.31

[1] Table adapted from Ref. (6); all cost and revenues revised to December 1973, and were expressed on the basis of plant yield (see Table 25).

[2] Product prices revised to December 1973 Ref. (63).

[3] It was learned (65) that this material is distillate bottoms high in metal content. This by-product used to be considered a waste product of low value. The source (65) is aware of only one re-refining plant which is selling the material to an asphalt firm. However, it was also learned (66) that given the current energy crisis, this material is probably blended with virgin fuel oil and burned. Hence, while the market value of this waste product was once questionable, it's value does appear to be increasing. Therefore, it is included as a return on investment to the re-refining processes which produce it.

Table 28 presents the costs of producing a single grade (SAE 30) top quality (SE grade) motor oil for sales in several markets; non-containerized bulk shipments, bulk shipments in 55 gallon drums, and retail (oil containerized in quart cans).

The production of an SE grade, SAE 30 weight oil requires the addition of a performance package and viscosity improver to the unblended base stock. Adding 3% (by volume) viscosity improver (polyisobutylene) and 6.8% (by volume) performance package to 90.2% of a gallon unblended lube oil base stock gives a gallon of SE grade, SAE 30 weight oil. The addition of the viscosity improver and performance package costs 19.07¢ per gallon of finished product. Hence, the total costs of producing an unpackaged lube oil of top quality varies between 38.59¢ and 45.72¢ a gallon for the distillation/clay process to 42.99¢ and 50.51¢ a gallon for the acid/clay process. Costs for the other two re-refining processes lie in between these two extremes.

A packaging cost of 8.62¢ to 12.00¢ per gallon is incurred when re-refined oil is sold to bulk accounts which require the oil to be containerized. This expense represents the reconditioning cost for 55 gallon barrels. The drums must be cleaned and repainted before they can be put into service after initial use. The total costs of producing for containerized bulk accounts ranges from 51.61 to 62.51¢ per gallon for the acid/clay process to 47.21¢ to 57.72¢ for the distillation/clay/process.

Producing re-refined oil for sale in the retail market usually means that the oil is canned in quart size containers. One can see from Table 28 that canning costs amount to 37.70¢ per gallon of finished product. The total costs of producing re-refined lube oil for the retail market amounts to 89.31¢ to 100.21¢ per gallon with the acid/clay process. Use of the distillation/clay process yields a lower cost between 84.91¢ and 95.42¢ per gallon of finished product.*

Table 29 shows the net profit a re-refiner could obtain by selling his high-quality lube oil in bulk lots. The net profit range received by using the acid/clay process ranges between 22.49¢ and 32.01¢ per gallon. The distillation/clay process returns between 27.28¢ and 36.41¢ per gallon. The other two process technologies yield net profits between these two extremes.

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*It should be pointed out that only a very small percentage of re-refined oil is sold in the retail market. Re-refined lube oil sold in the retail market competes with cheap, low quality virgin oil. There are at least two reasons for this. The re-refining industry has had a history of opportunists with questionable integrity. The FTC labeling act has also served to discourage public acceptance of re-refined oil. As a result, today most retail consumers seeking a quality oil would not buy a re-refined product (45). The retail example has been added to show revenue/cost potential if the re-refiners were able to sell all their oil to the retail market.

TABLE 28. POTENTIAL COST OF PRODUCING SE GRADE, SAE 30 OIL FOR DIFFERENT MARKETS1/
(All costs in center per gallon)

		ACID/CLAY	EXTR./ACID/CLAY	DIST./CLAY	DIST./H2
Total Costs of Producing Unblended Base Stock (From Table 27)		26.52-34.86	22.65-29.80	21.64-29.54	23.31-31.21
Costs of Producing One Gallon of SE Grade, SAE 30 Oil1/					
Unblended base stock (0.9020 gal.)		23.92-31.44	20.43-26.88	19.52-26.65	21.03-28.15
Viscosity Improver (0.03 gal.)2/	3.13				
Performance package (0.068 gal.)3/	15.98				
Sub-Total	19.11	19.07	19.07	19.07	19.07
Total Costs (blended oil not containerized)		42.99-50.51	39.50-45.95	38.59-45.72	40.10-47.22
Add drumming4/ to total costs blended oil		8.62-12.00	8.62-12.00	8.62-12.00	8.62-12.00
Total Costs for Bulk5/ Accounts (containerized)		51.61-62.51	48.12-57.95	47.21-57.72	48.72-59.22
Add earning4/ to total costs blended oil		37.70	37.70	37.70	37.70
Total Costs for Retail Sales		89.31-100.21	85.82-95.65	84.91-95.42	86.42-96.92

1/ Figures adapted from Ref. (45)

2/ Adjusted to December 1973 basis as per conversation with Mr. Roy Banks (Bayside Oil Corp.; Sal Carlos, California), February 1974

3/ Adjusted by the wholesale price index for all commodities to December 1973 (53). Addition of both the viscosity improvement and performance package raises the viscosity of the oil from 55 Saybolt Universal Seconds (SUS) to 64 SUS at 210°F.

4/ Adjusted by the wholesale price index for all commodities to December 1973 (53). As per conversation with Mr. Belton Williams, March 7, 1974.

5/ Containerized bulk accounts include jobbers, commercial, and industrial establishments who buy their oil in 55 gallon drums.

TABLE 29. POTENTIAL PROFITABILITY OF SELLING RE-REFINED SE GRADE SAE 30 UNCONTAINERIZED OIL IN BULK MARKETS

(All costs/revenues in centers per gallon)

	Acid/Clay	Extr./Acid/Clay	Dist./Clay	Dist./H_2
Sales price blended Oil - bulk lots 1/	73.00-75.00	73.00-75.00	73.00-75.00	73.00-75.00
Total costs of producing blended oil (from Table 28)	42.99-50.51	39.50-45.95	38.59-45.72	40.10-47.22
Net profit range-non-containerized shipments	22.49-32.01	27.05-35.50	27.28-36.41	25.78-34.90

1/ Adjusted to December 1973. As per conversation with Mr. Banks and Mr. Williams, March, 1974.

Table 30 presents the potential profit which could accrue to each process technology as a consequence of selling re-refined, SE grade SAE 30 weight oil to various markets. In Table 30, one can see that the sale price of the lube oil to jobbers is approximately 76¢ to 84¢ per gallon. The approximate net profit to the re-refiner at this sale price ranges between 13.49¢ to 32.39¢ per gallon for the acid/clay process, to a return of 18.28¢ to 36.79¢ per gallon for the distillation/clay process.

The sales price of SE grade, SAE 30 weight oil to commercial accounts is between 95¢ and 113¢ per gallon. The net profit of re-refiners selling to this market would range between 32.49¢ to 61.39¢ per gallon with the acid/clay process. The distillation/clay process would return between 37.28¢ and 65.79¢ per gallon.

As has been previously mentioned, the sale of good quality re-refined oils to the retail market represents a small part of the sum total of re-refined oil sales. However, as shown by Table 30, if the stigma associated with re-refined oils could be overcome, the selling of good quality re-refined oil in the retail market could be very profitable. For purposes of this analysis, it is assumed that the retail price of re-refined lube oil is $1.75 per gallon. Hence, the net profit range would vary between 74.79¢ and 85.69¢ per gallon for the acid/clay process. For the distillation/clay process the net profit per gallon for retail sales would be approximately 79.58¢ to 90.09¢ per gallon.

In essence, the re-refiner could attempt to sell a blended product equivalent in quality to major brand virgin oils. However, given the current situation and the public's opinion about re-refined oil, it is highly unlikely that sales to the retail market by the re-refiner would be of sufficient volume to make it economically feasible.

TABLE 30. POTENTIAL PROFITABILITY OF SELLING CONTAINERIZED RE-REFINED SE GRADE, SAE 30 OIL TO JOBBERS, COMMERCIAL, INDUSTRIAL AND RETAIL ACCOUNTS
(All Costs/Revenues in Cents per Gallon)

	Acid/Clay	Extr./Acid/Clay	Dist./Clay	Dist./H_2
Sales price of SE Grade, SAE 30 Oil - Jobbers 1/	76.00-84.00	76.00-84.00	76.00-84.00	76.00-84.00
Costs of blended SE Grade, SAE 30 Oil for Sale to Containerized Bulk Accounts (from Table 28)	51.61-62.51	48.12-57.95	47.21-57.72	48.72-59.22
Net Profit Range - Jobbers 1/	13.49-32.39	18.05-35.88	18.28-36.79	16.78-35.28
Sales price of SE Grade, SAE 30 Oil - Commercial - Industrial Accounts 2/	95.00-113.00	95.00-113.00	95.00-113.00	95.00-113.00
Costs of blended SE Grade, SAE 30 Oil for Sale to Containerized Bulk Accounts (from Table 28)	51.61-62.51	48.12-57.95	47.21-57.72	48.72-59.22
Net Profit Range - Commercial - Industrial 1/	32.49-61.39	37.05-64.88	37.28-65.79	35.78-64.28
Sales price of SE Grade, SAE 30 Oil - Retail 3/	175.00	175.00	175.00	175.00
Costs of blended SE Grade, SAE 30 Oil for Sale to Retail Accounts (from Table 28)	89.31-100.21	85.82-95.65	84.91-95.42	86.42-96.92
Net Profit Range - Retail Accounts 1/	74.79-85.69	79.35-89.18	79.58-90.09	78.08-88.58

1/ Most re-refiners do not employ salesmen to sell their products at the wholesale and/or retail level. Most of the selling is done by the manager of the firm. Hence, selling expenses are part of the managers salary, and are not specifically segregated out here.

2/ Figures adjusted to December 1973.

3/ Sold in retail markets directly to the customer. This type of sale is rare for reasons given in the text of the report. Figures have been adjusted to December 1973.

BURNING WASTE OIL, AS A FUEL

Waste oil contains the same BTU content per pound as does virgin oil (3). Waste oil is also low in sulfur content which is desirable from an environmental standpoint in meeting ambient air pollution standards for sulfur. However, waste crankcase oil does contain high concentrations of lead. When waste oil is burned, the lead is emitted to the atmosphere as submicron range particles which potentially can endanger health.

Several items must be considered in economically evaluating the feasibility of burning waste oil. The first item is to identify and evaluate the technical factors and costs which would allow waste oil to be burned such that the additional risk to human health from lead emissions is acceptably minimized. Included within such an examination is an economic evaluation of the trade-offs involved in using waste oil versus virgin fuel oil in combustion practices. Particular emphasis is placed on burner technology, waste oil quality (including identifying and evaluating the costs of various pretreatment processes that may be specified), and air pollution control equipment as they effect emissions. Other costs considered in the evaluation include increased operating and maintenance costs of boiler or incinerator facilities which may result from burning waste oil. In conjunction with this the federal, state, and local laws affecting the burning of waste oil must be delineated. The relative economic impact of these laws should be determined where possible particularly their impact on the operating and maintenance costs of the combustion facility, and the demand for different fuel oils. The effects, if any, of these laws on the relative prices of fuel oils, including waste oil used as fuel oil, is also considered.

The G.C.A. Technology Division, Bedford, Massachusetts, under contract to the Environmental Protection Agency, investigated the burning of waste automotive lubricating oil as a fuel. Their findings are summarized below (34).

POTENTIAL MARKETABILITY OF WASTE OIL AS A FUEL

If waste oil is burned as a fuel, either treated or untreated, it should be recognized that it potentially represents only a small part of the total petroleum used as a fuel in the United States. More specifically, if all waste oil generated annually were available for fuel reuse, this total fuel energy would represent less than 1.0 percent of the total annual coal and crude oil energy production in the United States. Waste oil fuels, therefore, may serve as incremental regional supply inputs to supplement existing domestic fuel supplies.

As mentioned previously, waste oil generation is a variable process. The variation occurs over space and time, and hence affects the regularity and supply of waste oil available for fuel usage. In the short run, use of waste oil as a fuel may be restricted to use as a supplemental fuel, while in the longer term, systems may be developed to promote supply regularity through improved collection, storage and/or pretreatment, and distribution systems.

A range of alternate blended and unblended waste oil fuel products may be marketed based on the extent of untreated oil reprocessing and the nature of fuel combustion. Associated with this range of waste oil fuel products is a range of market prices, with differences reflecting the degree of reprocessing and handling.

Comparative fuel costs for coal, virgin fuel oils, and untreated waste oil show a competitive advantage for waste oil in present fuel markets. Average prices for untreated waste oil in December 1973 were about 34 percent of average distillate fuel oil prices and 45 percent of residual oil prices. This fuel price advantage leaves a cost margin for pretreatment to meet technical and environmental quality specifications.

Rapidly expanding national fuel energy consumption, combined with an unstable foreign petroleum supply market, have created a domestic fuel market supply-demand imbalance. This imbalance requires expanded domestic energy production, energy conservation, and development of new fuel supply forms and sources. Reuse of waste oil as a fuel, where health risks are acceptably minimized (as previously discussed) and where it is economically efficient to do so, promotes energy conservation and provides a supplemental fuel supply source to help meet demand.

The electrical power industry, which accounts for about 25 percent of the Nation's total annual fossil fuel consumption, represents a large potential demand market for waste oil fuels in most regions of the Nation. Some electric power plants are currently combusting waste oil routinely or are testing waste oil fuels for potential routine usage; and 86.5 percent, or 59 of 68 electric utility companies responding to a nationwide survey, felt that some form of a waste oil fuel product could be used at their facilities.

The industrial sector of the economy, presently the largest consumer of energy in the United States using about 30 percent of the Nation's annual energy input, contains numerous process applications to which waste oil fuels may be applied. Several industrial plant operating factors may serve as criteria in identifying potential users of waste oil fuels. These criteria would include, among others, the following:

- Present fuel energy consumption levels
- Installed particulate matter emission control technology employed
- Present trends in waste oil fuel use and/or combustion testing

Based on these factors, selected firms in the following Department of Commerce Industrial categories could represent prime potential consumers: (1) lumber and wood products, (2) paper and allied products, (3) chemical and plastic products, (4) petroleum and coal products, (5) rubber and plastic products, (6) stone, clay, and glass products, and (7) primary metal industries. In general, industrial firms are more heterogeneous in character than electric power plants, and hence would require more detailed analysis of fuel logistical utilization methods before potential waste oil users could be identified at the regional level.

The ultimate sale and use of waste oil fuels will probably be affected by a number of institutional constraints, which are geographically and/or application specific. These laws (constraints) imply higher waste oil fuel users costs, a restricted range of user applications, and a decrease in overall demand for the use of waste oil as a fuel. For purposes of discussion, the institutional constraints may be divided into the following categories:

a. Laws and regulations which are uniquely applicable only to waste oil. These are presently limited, but generally could be considered favorable toward encouraging waste oil fuel usage. These constraints tend to restrict the marketability of waste oil derived products relative to virgin oil derived products thereby restricting the range of economically viable waste oil reuse options. Examples of such laws at the Federal level would include the I.R.S. interpretation of the Excise Tax Reduction Act of 1965, and the F.T.C. labelling requirements (Appendices E and D).

b. Environmental management and pollution control actions directly affecting the use of waste oil fuel. Existing or anticipated air quality and emission standards directly govern the acceptable quality of waste oil fuel at the federal, state, and/or local levels. These include particulate matter standards and hazardous pollutant standards for lead and other metallic and inorganic pollutant standards found in waste oil (Appendix F).

c. Environmental control actions indirectly influencing waste oil fuel use. These actions generally tend to enhance its marketability potential. First, air pollution emission controls have resulted in the installation of stack gas effluent controls which may remove harmful particle emissions from waste oil combustion without a large additional outlay of capital for control hardware. Second, sulfur oxide emission controls and fuel sulfur content regulations tend to improve the market demand for recovered waste oils low in sulfur for use as blended fuels.

Technical problems have been encountered as a result of untreated waste oil combustion. These problems previously discussed in Section VII occur primarily because of the level and the variability of contaminates or untreated waste oils.

IMPACT REDUCTION ALTERNATIVES -- PRETREATMENT

Technical and environmental impacts can be alleviated by employing various levels of existing technology to pretreat waste oil prior to combustion. The pretreatment techniques have been discussed in Section VII.

IMPACT REDUCTION ALTERNATIVES -- EMISSION CONTROL SYSTEMS

High efficiency particulate control devices can reduce lead and other submicron-sized emissions and therefore their resulting contributions to ambient concentrations by one to two orders of magnitude (i.e., 90 to 99 percent control). Fabric filter baghouses, properly designed electrostatic precipitators, and to a lesser degree high energy venturi scrubbers, are all capable of this range of performance.

CAPITAL INVESTMENT AND OPERATING COSTS FOR IMPACT REDUCTION ALTERNATIVES

The capital investment and operating costs associated with waste oil pretreatment options and emission control systems are summarized in Table 31. These pretreatment costs are based on a pretreatment plant capacity of 15,000,000 gallons per year (85 percent yield or 12,750,000 gallons per year output for settling, centrifugation, and solvent extraction; 70 percent yield or 10,500,000 gallons per year for vacuum distillation). The costs associated with the emission control systems are based upon a stack flow of one million actual cube feet per minute (ACFM). This is the approximate stack flow of a large utility boiler (~500 MW) utilizing 12,750,000 gallons per year of waste oil to supply 5 percent of its energy requirements; a reasonable example of a large-scale application for waste oil fuel utilization. Capital and operating costs for different capacities can be obtained from Figures presented later in this Section.

The Economics of Impact Reduction Alternatives: The economics associated with the waste oil treatment and particulate control systems discussed in the previous section include the development of capital investment and operating costs for each impact reduction alternative. Factors which permit the calculation of these costs for alternative capacities are presented. The presentation of these costs, however, will be preceded by a discussion of the assumptions utilized in their development.

TABLE 31. COST OF IMPACT REDUCTION ALTERNATIVES IN THE BURNING OF WASTE OIL (34)

	Capital Investment		Annual Operating Cost	
Impact Reduction Alternative	Millions of $'s	¢/gal. of Waste Oil	Millions of $'s	¢/gal. of Waste Oil
Pretreatment Options:				
Settling	1.23	10	1.39-1.42	10.86-19.01
Centrifugation	1.15	9	1.32-2.33	10.36-18.30
Vacuum Distillation	1.52	14	1.30-2.31	12.35-21.98
Solvent Extraction	1.50	12	1.58-2.60	12.39-20.40
Emission Control Options:				
Precipitators	2.60	20	0.28-0.31	2.18-2.46
Fabric Filtration	2.38	19	0.96	7.53
High Energy Scrubbers	1.96	15	0.87	6.82

BASIS FOR COST ESTIMATES

Capital Equipment Costs. The data utilized for purchased equipment costs were obtained both through personal communications with equipment manufacturers (54) and the use of the latest published information. In all cases the capital investments are on the common basis of construction and equipment costs for the Northeastern United States, in 1973 dollars. Table 32 presents the assumptions utilized in the development of capital investment costs.

The scale factor for determining capital investment costs for varying plant capacities is 0.6. This was developed from primary cost data developed by GCA (34) for plants of three capacities (1 million, 7 million, and 15 million gallons per year).

Annual Operating Costs. The annual operating costs include the following fixed, variable, and semi-variable costs:

Fixed Costs -

1. Amortization of capital investment - The capital investments have been amortized over a period of 20 years. This reflects the expected lifetime of the equipment based upon discussions with the equipment manufacturers. A straight line method, which distributes the capital investment cost uniformly over the 20-year period, has been used. Size scaling for this and all other fixed cost items should be proportional to the scale factor used for capital investment costs.

2. Insurance and property taxes - The cost of insurance was estimated to be 3.0 percent of total capital investment (45).

Variable and Semi-Variable Costs -

1. Waste oil - For treatment processes, an average wholesale cost of 6 - 12 cents per gallon was assigned to waste oil. This reflects examination of the recent literature and discussions with waste oil users (21, 63). The term wholesale implies that the waste oil is delivered directly to the treatment facility from the generating source, without intermediate storage and handling.

The cost of waste oil for systems of different sizes will vary directly with the size. The scale factor is therefore equal to 1.0.

2. Labor costs - The annual labor costs associated with the operation of the treatment and control facilities was obtained by taking the number of manhours required during the year and applying a wage rate of $5 - $7.50/manhour.

TABLE 32. ASSUMPTIONS MADE IN THE DEVELOPMENT OF CAPITAL INVESTMENT COSTS 1/

Category	Assumed Percentage of Purchased Equipment Costs	
	Treatment Plants	Particulate Control Systems
1. Equipment Installation	36	
2. Piping	32	Capital Cost
3. Electrical	20	Derived From
4. Instrumentation and Controls	28	Literature
5. Buildings	20	Review
6. Yard Improvements	8	
7. Land	4	
8. Engineering & Supervision	40	
9. Construction Expenses	48	
0. Contractor's Fee	8	
1. Contingency	32	

1/ Adapted from Ref. 34.

For purposes of this study, a scale factor of 0.25 has been used for determining labor costs as a function of size. This factor is taken from an article by F. P. O'Connel in "Modern Cost-Engineering Techniques" (55) and is based on data gathered for 52 chemical processes.

3. Maintenance costs - An annual maintenance cost of 5 - 7 percent of the capital equipment cost was selected for this analysis. This is a high figure representative of that normally found for corrosive processes. Since maintenance costs have been estimated as a percentage of equipment costs, the equipment cost scale factor should be applied to determine the cost of other size installations.

4. Overhead costs - The costs of overhead were estimated at 40 percent of labor and supervision.

5. Electrical costs - Electrical costs were estimated at 1.5¢ to 3.0¢ per KWH. Since electrical requirements will vary directly with plant capacity, it has a scale factor of 1.0.

6. Caustic soda costs - The cost of the requisite caustic soda necessary for these treatment processes is based upon communication with producers.

7. Demulsifier surfactant - The cost of the required demulsifier surfactant is based upon communication with producers (56). Scale factor equals 1.0.

PRESENTATION OF DATA

The following tables present the initial capital investment and annual operating costs associated with the various pretreatment and emission control alternatives:

Settling. As shown in Table 33 treatment by settling involves an initial capital outlay of $1.23 million. This facility would operate 24 hours per day, 313 days per year, as would the other systems discussed below. It is estimated that this system would process 15 million gallons of waste oil and would yield 12.75 million gallons of waste oil fuel product (85 percent of feed input). Given the annual operating cost (in Table 34) the product would cost approximately 10.86 - 19.01 cents per gallon to produce.

Centrifugation. As shown in Tables 35 and 36, the initial capital outlay for a facility of this nature would be $1.15 million with an annual operating cost of $1.32 - $2.33 million. The amount of waste oil fuel product would be 12.75 million gallons (85 percent yield) at a processing cost of 10.36 - 18.30 cents per gallon.

TABLE 33. CAPITAL COST ESTIMATION OF TREATMENT FACILITY: SETTLING 1/

Processing Capacity: 15 million gallons/yr
Plant Operation: 24 hr/day - 313 days/yr
Process Yield: 85% (12,750,000 gallons finished product)

Direct Costs		
Installed Equipment Cost		
Purchased Equipment	$311,910	
Installation	112,290	
Piping	99,810	
Electrical	62,380	
Instrumentation & Controls	87,335	
	$673,725	
Land and Improvements		
Buildings	62,382	
Yard Improvements	24,953	
Service Facilities	56,700	
Land	12,476	
	$156,511	
Total Direct Costs		$830,236
Indirect Costs		
Engineering and Supervision	$124,765	
Construction Expense	149,718	
Contractor's Fee	24,953	
Contingency	99,812	
Total Indirect Costs		$399,248
TOTAL CAPITAL INVESTMENT		$1,229,484

1/ Adapted from Ref. 34.

TABLE 34. ESTIMATED OPERATING COST OF TREATMENT FACILITY: SETTLING1/

Total Capital Investment (C.1.) see Table 33	$1,229,484	
Fixed Costs	Annual Cost	Cost Per Gallon Finished Prod. ¢/gal
Amortization at 5% of Total C.1.	$ 61,474	0.48
Insurance and Local Taxes (3.0% of C.1.)	36,885	0.29
TOTAL FIXED COST PER YEAR	$ 98,359	0.77
Variable and Semi-Variable Costs		
Residual Fuels (20¢/gal)	$ 42,700	0.33
Electric Power (1.50-3.00¢/KWH)	1,090-2,180	0.01-0.02
Waste Oil Feed (6-12¢/gal)	900,000-1,800,000	7.06-14.12
Labor (30,048 manhrs at $5.00-7.50/manhr)	150,240-225,360	1.18-1.77
Overhead (50% of labor)	75,120-112,680	0.59-0.88
Caustic Soda	115	*
Demulsifier Surfactant	56,250	0.44
Maintenance (5-7 percent of fixed C.I.)	61,474-86,064	0.48-0.68
Total Variable Cost Per Year	$1,286,989-2,325,349	10.09-18.24
TOTAL ANNUAL COST	$1,385,348-2,423,708	10.86-19.01

1/ Adapted from Ref. 34

* Costs too small on a per-gallon basis to be expressed.

TABLE 35: CAPITAL COST ESTIMATION OF TREATMENT FACILITY: CENTRIFUGATION1/

Processing Capacity: 15 million gal/yr
Plant Operation: 24 hr/day - 313 days/yr
Process Yield: 85% (12,750,000 gallons finished product)

Direct Costs		
Installed Equipment Costs		
Purchased Equipment	$290,718	
Installation	104,658	
Piping	93,030	
Electrical	58,144	
Instrumentation & Controls	81,401	
	$627,951	
Land and Improvements		
Buildings	$ 58,144	
Yard Improvements	23,257	
Service Facilities	56,700	
Land	11,629	
	$149,730	$777,681
Indirect Costs		
Engineering and Supervision	$116,285	
Construction Expense	139,545	
Contractor's Fee	23,260	
Contingency	93,030	
		$372,120
Total Capital Investment		$1,149,801

1/ Adapted from Ref. 34.

TABLE 36. ESTIMATED OPERATING COST OF TREATMENT FACILITY: CENTRIFUGATION1/

Total Capital Investment (C.I.) see Table 35	$1,149,801	
Fixed Costs	Annual Cost	Cost/Gal Finished Prod. (¢/Gal)
Amortization at 5% of total C.I.	$57,490	0.45
Insurance and local taxes (3.0% of C.I.)	34,494	0.27
Total Fixed Cost Per Yr	91,984	0.72
Variable and Semi-Variable Costs		
Residual Fuels (20¢/gal)	$42,700	0.33
Electric Power (1.50-3.00¢/KWH)	3,817-7,634	0.03-0.05
Waste Oil Feed (6-12¢/gal)	900,000-1,800-000	7.06-14.12
Labor (22,536 manhrs at $5.00-7.50/manhr)	112,680-169,020	0.88-1.33
Overhead (50% of labor)	56,340-84,510	0.44-0.66
Caustic Soda	115	2/
Demulsifier Surfactant	56,250	0.44
Maintenance (5-7 percent of Fixed C.I.)	57,490-80,486	0.45-0.63
Total Variable Cost Per Yr	$1,229,392-2,240,715	9.64-17.57
Total Annual Cost	$1,321,376-2,332,699	10.36-18.30

1/ Adapted from Ref. 34.
2/ Costs too small on ¢/gal basis to be expressed.

Distillation. Table 37 shows a total capital investment of approximately 1.5 million for a vacuum distillation treatment facility. This technique yields an annual output of 10.5 million gallons (70 percent of feed input). As shown in Table 38, the annual operating cost appreciated with this technique is $1.30 - $2.31 million. The processing cost is 12.35 - 21.98 cents per gallon of waste oil product.

Solvent Extraction. Tables 39 and 40 present, respectively, the initial capital investment and annual operating cost associated with solvent extraction. This process requires an outlay of $1.50 million with a $1.58 - $2.60 million annual operating cost. The waste oil fuel product produced by this technique is 85 percent of the feed input, or 12.75 million gallons. The process cost is 12.39 - 20.40 cents per gallon.

Electro-Static Precipitators. Tables 41 and 42 present the cost considerations involved in the erection and operation of precipitators. As with the other emission control devices discussed in this section, it is assumed that the stack flow is 1 million cubic feet per minute (cfm). This is the approximate stack flow of a large scale facility which could potentially utilize the output quantity from the pretreatment options discussed above. A precipitator of this size would cost approximately $2,660,000 million with an annual operating cost of $277,626 to $313,559.

Fabric Filtration. Table 43 shows the capital cost to be $2.38 million for a fabric filtration facility. This estimate is based upon an average cost of $2.38 per cfm (61). The operating cost is $960,400 annually as seen in Table 44.

High Energy Venturi Scrubber. As shown in Table 45 the estimated capital expenditure for a high energy venturi scrubber is $1.96 million. Table 46 shows the annual operating cost to be $869,217.

Summary of Impact Reduction Alternatives. Table 47 presents in summary fashion the capital cost and annual operating cost associated with each impact reduction alternative.

EFFECT OF CAPACITY ON ECONOMICS OF IMPACT REDUCTION ALTERNATIVES

Treatment Facilities. Figure 9 provides a means of estimating the capital investment and operating cost associated with pretreatment capacities other than 15 million gallons per year. These curves are based upon the scale factor associated with each of the costs as discussed above. This data can be applied to any of the processes discussed. For example, the costs associated with a treatment facility processing 22.5 million gallons per year by settling are:

TABLE 37. CAPITAL COST ESTIMATE OF TREATMENT FACILITY: VACUUM DISTILLATION[1]

Processing Capacity: 15 million gallons/yr.
Plant Operation: 24 hr./day - 313 days/yr.
Process Yield: 70 percent (10,500,000 gallons finished product)

Direct Costs		
Installed Equipment Costs		
Purchased Equipment	$346,229	
Installation	124,642	
Piping	110,793	
Electrical	69,246	
Instrumentation & Controls	96,944	
	$747,854	
Land and Improvements		
Buildings	$69,246	
Yard Improvements	27,698	
Service Facilities	222,500	
Land	13,849	
	$333,293	
Total Direct Costs		$1,081,147
Indirect Costs		
Engineering and Supervision	$138,492	
Construction Expense	166,190	
Contractor's Fee	27,698	
Contingency	110,793	
	$443,173	
Total Indirect Costs		$ 443,173
TOTAL CAPITAL INVESTMENT		$1,524,320

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[1] Adapted from Ref. 34

TABLE 38. ESTIMATED OPERATING COST OF TREATMENT FACILITY: VACUUM DISTILLATION1/

Total Capital Investment (C.I.) - See Table 37. $1,524,319

Fixed Costs	Annual Cost	Cost Per Gallon Finished Product (Cents per gallon)
Amortization at 5 percent of total C.I.	$76,216	0.73
Insurance & Local Taxes (3.0 percent of C.I.)	45,730	0.44
Total Fixed Cost Per Year	$121,946	1.17
Variable and Semi-Variable Costs		
Residual Fuels (20¢ gallon)	$39,000	0.37
Electric Power (1.50¢ to 3.00¢/KWH)	1,963-3,926	0.02 - 0.04
Waste Oil Feed (6-12¢/gallon)	900,000-1,800,000	8.57 -17.14
Labor (22.536 manhours at $5.00-$7.50/manhour)	112,680-169,000	1.07 - 1.61
Overhead (40 percent of labor)	45,072- 67,608	0.42 - 0.64
Maintenance (5-7 percent of fixed C.I.)	76,216-106,702	0.73 - 1.02
Total Variable Cost Per Year	$1,174,931-$2,186,256	11.19 -20.83
Total Annual Cost	$1,296,877-$2,308,202	12.35 -21.98

1/ Adapted from Ref. 34

TABLE 39. CAPITAL COST ESTIMATE OF TREATMENT FACILITY: SOLVENT EXTRACTION[1]

Processing Capacity: 15 million gallons/yr.
Plant Operation: 24 hr./day - 318 days/yr.
Process Yield: 85 percent (12,750,000 gallons of finished product)

Direct Costs			$1,105,250
Installed Equipment Costs		$775,110	
. Purchased Equipment	$358,847		
. Installation	129,185		
. Piping	114,831		
. Electrical	71,769		
. Instrumental & Controls	100,477		
Land and Improvements		262,230	
. Buildings	71,769		
. Yard Improvements	28,708		
. Service Facilities	147,400		
. Land	14,353		
Indirect Costs		459,320	
Engineering and Supervision	143,540		
Construction Expense	172,250		
Contractor's Fee	28,700		
Contingency	114,830		
Total Capital Investment			$1,496,660

[1] Adapted from Ref. 34.

TABLE 40. ESTIMATED OPERATING COST OF TREATMENT FACILITY: SOLVENT EXTRACTION[1]

Total Capital Investment (C.I.) - See Table 39 $1,496,660

Fixed Costs	Annual Cost	Cost Per Gallon Finished Product (cents per gallon)
Amortization at 5% of C.I.	$74,833	0.59
Insurance & Local Taxes (3% of C.I.)	44,900	0.35
Total Fixed Cost Per Year	$119,733	0.94
Variable and Semi-Variable Costs		
Residual Fuels (20¢ gallon)	30,000	0.24
Electric Power (1.50¢ to 3.00¢/KWH)	12,634- 5,268	0.10 - 0.20
Waste Oil Feed (6¢-12¢/gallon)	900,000-1,800,000	7.06 -14.12
Labor (22,536 manhours at $5.00-$7.50/ manhour)	112,680- 169,020	0.88 - 1.33
Overhead Costs (40% of Labor)	45,072- 67,608	0.35 - 0.53
Maintenance (5%-7% of Fixed Capital Investment)	74,833- 104,766	0.59 - 0.82
Naptha (750,000 gal at 38¢/gallon)	285,000	2.24
Total Variable Cost Per Year	$1,460,219-$2,481,662	11.45 -19.46
Total Annual Cost	$1,579,952-$2,601,395	12.39 -20.40

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[1] Adapted from Ref. 34

TABLE 41. ESTIMATED CAPITAL COST OF PRECIPITATORS 1/

cfm 1,000,000	
Total Capital Investment	$2,600,000
Direct Costs	$1,574,820
Purchased Equipment	
Erection (foundation, erection, electrical)	
Indirect Costs	$1,025,180
Engineering and Supervision	
Ductwork	
Air Flow Regulators	

1/ Adapted from Ref. 34

TABLE 42. ESTIMATED OPERATING COST OF PRECIPITATOR1/

Total Capital Investment (C.I.) see Table 41, $2,600,000

Fixed Cost	Annual Cost
Amortization at 5% C.I.	$130,000
Insurance and Local Taxes (3.0% of C.I.)	78,000
Total Fixed Cost/Yr.	$208,000
Variable and Semi-Variable Cost	
Labor (675 manhrs at 5.00-7.50/manhr	$3,375-5,063
Maintenance (2% of Erected	31,496
Electric Power (at 1.5-3.0¢/KWH)	34,755-69,000
Total Variable Cost/Yr	$69,626-105.539
Total Annual Cost	$277,626-313,559

1/ Adapted from Ref. 34

TABLE 43. CAPITAL COST ESTIMATE OF FABRIC FILTRATION 1/

cfm: 1,000,000		
Total Capital Cost		$2,380,000
Planning and Design	$100,000	
F.O.B. Baghouse	800,000	
Freight	50,000	
Fan and Motor	250,000	
Ducting	650,000	
Disposal Equipment	100,000	
Instrumentation	50,000	
Foundations and Installation Labor	280,000	
Start-Up	100,000	

1/ Adapated from Ref. (34).

TABLE 44. ESTIMATED OPERATING COST FOR FABRIC FILTRATION [1]

Total Capital Investment (C.I.) see Table 43.	$2,380,000
Fixed Cost	Annual Cost
Amoritization at 5% C.I.	$119,000
Insurance and local Taxes (3.0% of C.I.)	71,400
Total Fixed Cost/Yr.	$190,400
Variable and Semi-Variable Cost	
Labor ($.30 per cfm)	$300,000
Electric Power (1.5¢/KWH) [2]	120,000
Plant Overhead ($.25/cfm)	250,000
Cloth Purchases ($.10/cfm)	100,000
Total Variable Cost/Yr	$770,000
Total Annual Cost	$960,400

[1] Adapted from Ref. 34

[2] Electric power costs vary on the average between 1.5¢ and 3.0¢ per kilowatt hour. The cost range was not adjusted to reflect this, as in previous tables, in order to preserve simplicity.

TABLE 45. CAPITAL COST ESTIMATE OF HIGH ENERGY VENTURI SCRUBBERS 1/

cfm: 1,000,000	
Total Capital Investment	$1,960,390
Purchased Equipment	
Installation	
Engineering Expense	
Start-Up	

1/ Adapted from Ref. (34).

TABLE 46. ESTIMATED OPERATING COST OF HIGH ENERGY VENTURI SCRUBBER 1/

Total Capital Investment (C.I.) see Table 45	$1,950,390
Fixed Cost	Annual Cost
Amortization at 5% (C.I.)	97,520
Insurance (3.00% of C.I.)	58,512
Total Fixed Cost/Yr	156,032
Variable and Semi-Variable Cost	
Labor and Maintenance (.01% of C.I.)	19,500
Electric Power (1.5¢/KWH) 2/	493,685
Water (.05/1000 gal)	200,000
Total Variable Cost/Yr	713,185
Total Annual Cost	$869,217

1/ Adapted from Ref. 34

2/ Electric power costs vary on the average between 1.5¢ and 3.0¢ per kilowatt hour. The cost range was not adjusted to reflect this, as in previous tables, in order to preserve simplicity.

TABLE 47. SUMMARY TABLE OF THE ECONOMICS OF IMPACT REDUCTION ALTERNATIVES 1/

Impact Reduction Alternatives	(millions of $) Initial Capital Investment	(millions of $) Annual Operating Cost
Settling	$1.23	$1.39 - $2.42
Centrifugation	1.15	1.32 - 2.33
Vacuum Distillation	1.52	1.30 - 2.31
Solvent Extraction	1.50	1.58 - 2.60
Precipitators	2.60	0.28 - 0.32
Fabric Filtration	2.38	0.96
High Energy Scrubbers	1.95	0.87

1/ Adapted from Ref. 34

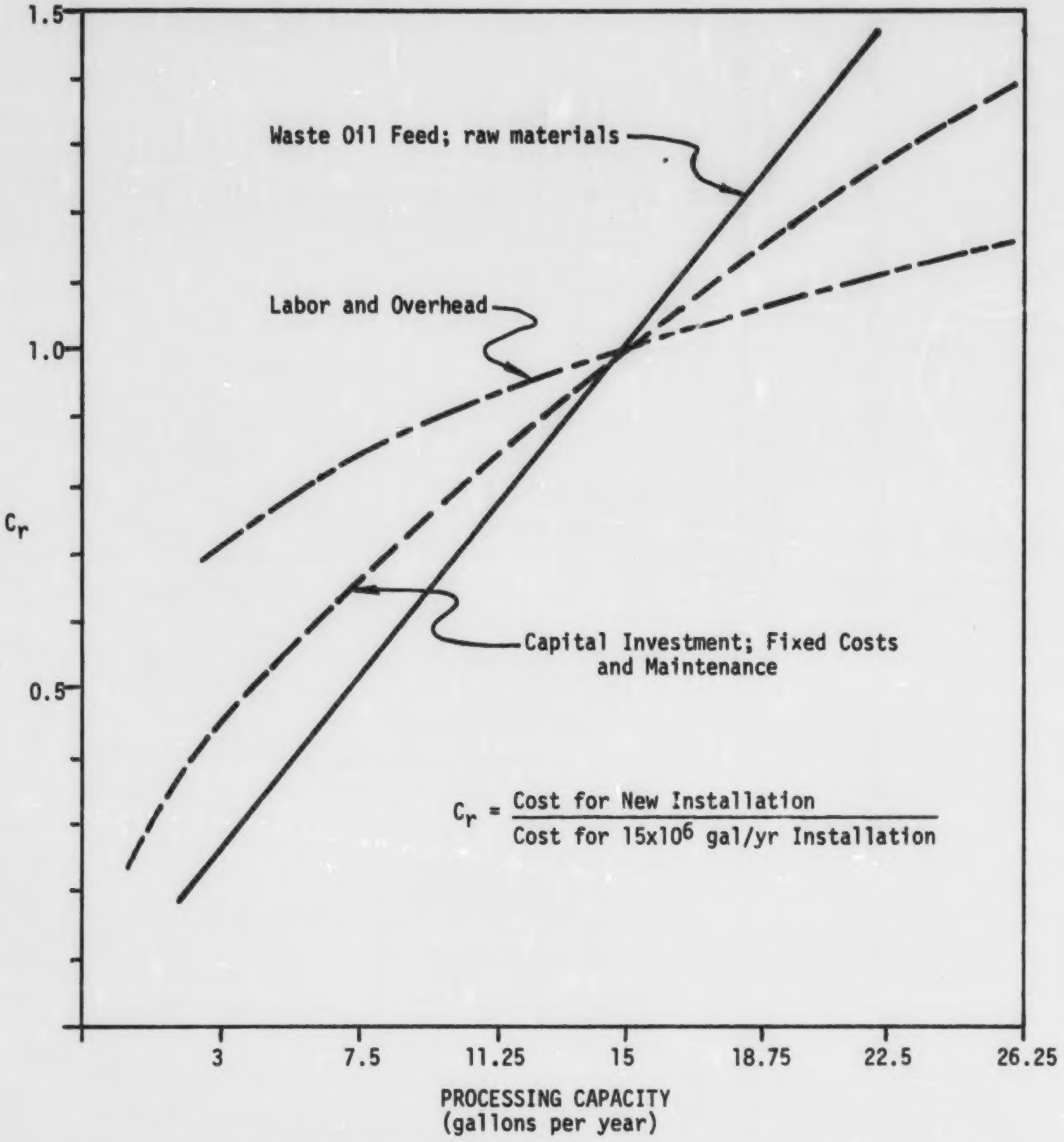

Figure 9 Investment and Operating Cost of Pretreatment as a Function of Treatment Facility Capacity

Capital Investment (1.27 x $1,229,484)	$1,561,444
Operating Costs	
Fixed Costs (1.27 x $98,359)	124,916
Waste Oil Feed (1.5 x $900,000 and 1.5 x $1,800,000)	1,350,000 - 2,700,000
Labor (1.11 x $150,240 and 1.11 x $2,700,000)	166,766 - 2,997,000
Overhead (1.11 x $75,120 and $112,680 x 1.11)	83.383 - 125,075
Raw Materials	
Caustic Soda (1.5 x $115)	175
Demulsifier Surfactant (1.5 x $56,250)	84,375
Maintenance (1.27 x $61,474 and 1.27 x $86,064)	78,072 - 109,301
Total Operating Cost	$3,449,131 - 7,577,370

There appear to be significant economies of scale in the operation of treatment facilities. Table 48 provides the processing cost in cents per gallon for different capacities. As shown by the data, lower average costs are arrived at through large scale operation. This is one factor which would support the construction of centralized rather than decentralized facilities.

Emission Control Devices. Figure 10 provides a means of estimating the capital cost and operating cost associated with emission capacities other than 1,000,000 cfm. These curves are based upon the scale factor associated with each of the costs as discussed above. The use of this figure parallels that of Figure 9.

TREATMENT VERSUS EMISSION CONTROL DEVICES

It is important to note that while both treatment and emission control devices are forms of impact reduction alternatives, a simple capital cost or operating cost comparison between any specific treatment alternative and a given emission control device is not desirable. The treatment alternatives discussed are evaluated from an entrepreneurial standpoint. The data presented serves as an indicator of the processing cost involved in producing a fuel product, specifically a waste oil fuel product. The costs are those of setting up and operating a business enterprise. Emission control devices represent an added expense, of both a capital cost and operating cost nature, to an ongoing

TABLE 48. AFFECT OF CAPACITY ON PROCESSING COST (CENTS PER GALLON)

Treatment Option	Capacity (million/gals.) 15	7	1
Settling	10.86-19.01	13.82-24.19	22.70-39.74
Centrifugation	10.36-18.30	13.47-23.79	19.69-34.77
Vacuum Distillation	12.35-21.99	15.44-27.49	23.67-42.15
Solvent Extraction	12.40-20.42	15.50-25.53	23.77-39.15

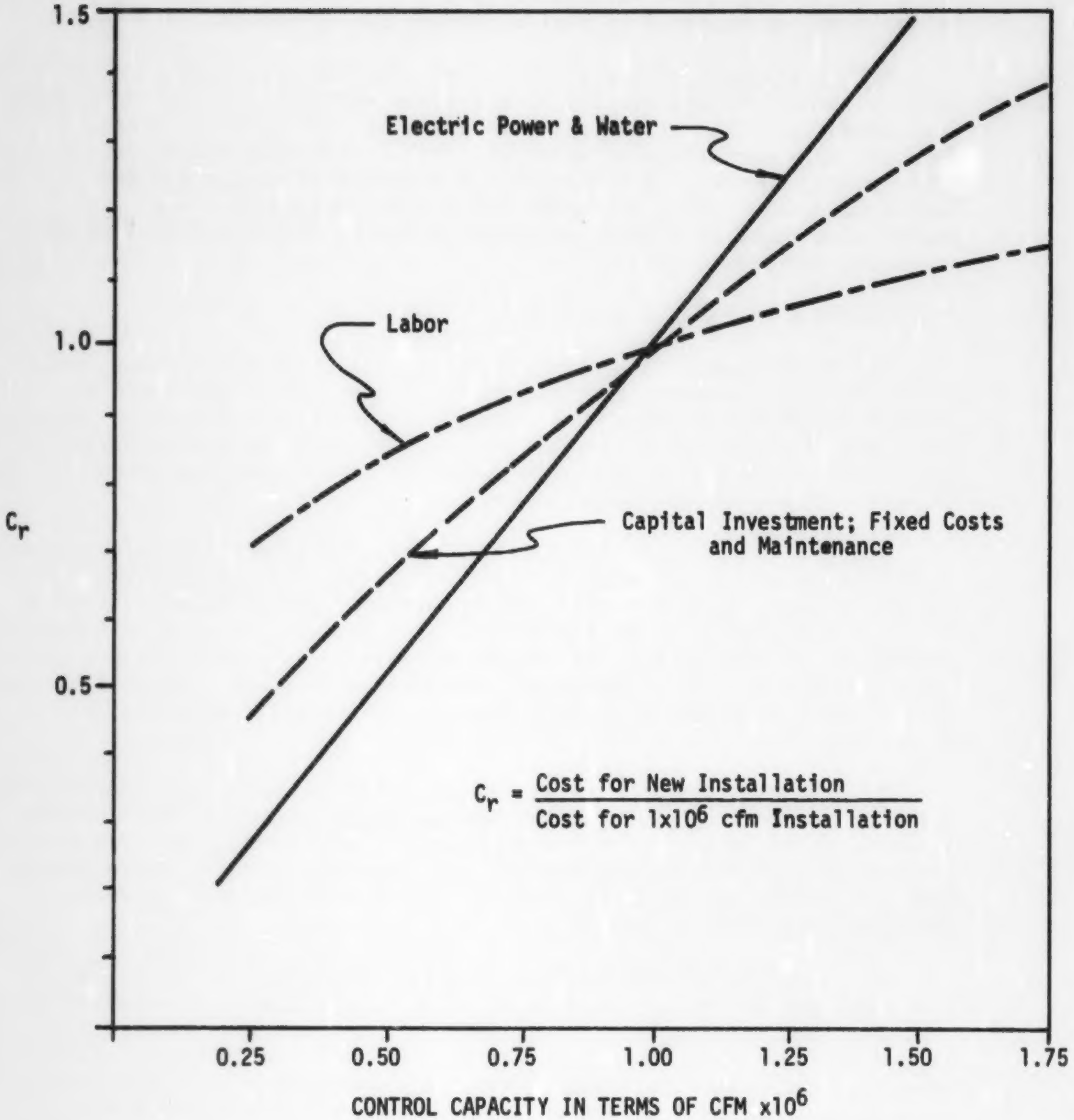

Figure 10 Investment and Operating Cost of Particulate Collection Equipment as a Function of Control Capacity

business establishment. To the extent a user of waste oil would have to bear these emission control costs, the additional expense would represent a deterrent to waste oil utilization unless these added costs are offset by fuel cost savings which arise from the lower selling price of waste oil as compared to that of virgin fuel products.

Market Analysis of Waste Oil Fuels. The following analyzes the primary market characteristics of the waste oil fuel product and blended fuel products. The selling price of waste oil is first discussed, followed by a comparison of waste oil fuel prices with the prices of other energy sources. A qualitative discussion of supply and demand factors affecting waste oil marketability is then carried out. This analysis is based on a waste oil plant treating 15,000,000 gallons of waste oil per year.

SELLING PRICE OF TREATED WASTE OIL

The first market consideration is the selling price of waste oil. It may be safely assumed that a high selling price for the waste oil product would deter from its widespread use as an energy source. Thus far, only the processing cost of waste oil has been mentioned. The additional determinants of market price are profit and distribution charges. These are discussed below.

Profit. The treatment facilities discussed in previous sections were viewed as an entrepreneurial enterprise. As such, it is imperative to include a profit margin in the selling price of the product as a return for entrepreneurial talent and effort. For purposes of this analysis, profit is assumed to be a 10% return on capital investment (before taxes). This is consistent with the return experienced in similar establishments (57). Table 49 presents the addition to selling price that reflects such a return.

Distribution Costs. The distribution of the waste oil product will increase the selling price by the expense associated with transporting the product to either the final user or to blend facilities. Transportation costs will be the same whether the treatment facility entrepreneur owns the trucks and pays the drivers' salaries or employs the services of a trucking firm.

It is estimated that the distribution of the product would add 4.5 cents per gallon to the selling price. This figure was derived by assuming that two trucks carrying 1500 gallons each made two round trips per day. Each round trip was assumed to be 200 miles. This is enough to distribute on a daily basis the amount of product produced in a 24-hour period. A cost of $1.46 per intercity vehicle mile traveled was applied based upon an updating of recent figures on motor vehicle expense (59). The transportation charge is simply the total vehicle expense divided by the number of gallons transported. The 4.5 cents per gallon figure appears to be compatible with other estimates of trucking costs.

TABLE 49. EFFECT OF PROFIT ON MARKET PRICE OF TREATED WASTE OIL

Treatment Process	Annual Profit (10% of Capital Investment)	Profit in cents/gal of Product
Settling	$122,948	0.96
Centrifugation	114,980	0.90
Vacuum Distillation	152,432	1.45
Solvent Extraction	149,166	1.17

TABLE 50. SELLING PRICE OF TREATED WASTE OIL (CENTS/GAL)

Treatment Option	Process Cost	Profit	Transport	Selling Price
Low Level of Treatment				
Settling	10.86-19.01	0.96	4.50	16.32-24.47
Centrifugation	10.36-18.30	0.90	4.50	15.76-23.70
High Level of Treatment				
Vacuum Distillation	12.35-21.98	1.45	4.50	18.30-27.93
Solvent Extraction	12.39-20.40	1.17	4.50	18.06-26.07

Price to User. The market price of the waste oil fuel product is a summation of the processing cost, profit markup, and distribution costs. Table 50 presents the selling price of the waste oil product according to the treatment process employed.

COMPARATIVE FUEL PRICES

Table 51 compares the prices of various energy sources to those of the waste oil product. While the data given are the most recent available, any long-run projection based upon them involves a high degree of uncertainty given the current chaos in the energy market. It does appear, however, that all levels of waste oil (high treated, low treated, and no treatment) can compare favorably with other fuel oil prices. This is not true with coal prices, however. Coal is less expensive than any of the waste oil fuels in terms of cents per million BTU.

Since the potential supply of the waste oil product is a small percentage of total energy demands, and given technical and environmental consideration, it may be advisable to combust a blended product. Table 52 lists the prices of various blended fuels. The blend percentages given refer to the percentage, by weight, of waste oil used. As shown by this table, as the blend percentage increases, the cost per million BTU declines with fuel oil blends while it increases with waste oil-coal blends. The blended product prices increase as the level of waste oil treatment increases.

DEMAND FACTORS AFFECTING MARKETABILITY

The selling price serves as a first indicator of successful marketability. Those factors, other than price which influence demand, will now be discussed. The most significant of these are any additional expenses that may arise from waste oil combustion. These added costs take the form of additional labor, maintenance, and equipment costs. Labor, maintenance, and equipment costs may be viewed as dependent variables with the blend percentage, blend product, treatment level, nature of uses, and volume of uses representing independent variables. The nature of the changes in these costs as they relate to the independent variables follows.

Labor Costs

Increase as the blend percentage increases due to added equipment and maintenance requirements

Decrease as treatment level increases

Remain constant over different user range

Increase as use volume increases

TABLE 51. SELLING PRICE COMPARISONS OF VIRGIN FOSSIL FUELS AND WASTE OIL FUELS 1/

Fuel Type	Cents Per Million BTU	Cents Per Gallon
Untreated waste oil (Dec. 73)	43.17-86.33	6.00-12.00
Low treated waste oil	108.69-168.26	15.76-24.47
High treated waste oil	124.55-192.62	18.06-27.93
Residual oil(less than 0.5% Sulfur; Jan. 73) 2/	151.32-164.47	23.00-25.00
Residual oil (0.5-1.0% Sulfur; Jan. 73) 3/	115.13	17.50
Distillate oil (Jan. 73)	136.86-246.35	18.75-33.75
Coal (greater than 3% Sulfur; 1973)	39.1	NA
Coal (1-3% sulfur; 1973)	44.1	NA
Coal (less than 1% sulfur; 1973)	47.5	NA

1/ Adapted from Ref. 34

2/ New York spot price, Number 6 fuel oil; 0.3% sulfur: (68)

3/ New York spot price, Number 6 fuel oil, 1% sulfur: (68)

4/ Chicago Midwest Wholesale, Number 2 Fuel oil: (68)

TABLE 52. SELLING PRICE OF BLENDED WASTE OIL PRODUCTS (CENTS/MILLION BTU)

Blend Ratio (% waste oil by weight)	Untreated Waste Oil			Low Treated Waste Oil			High Treated Waste Oil		
	Blended With			Blended With			Blended With		
	#2	#6	Coal	#2	#6	Coal	#2	#6	Coal
0	191.60	131.60	38.96	191.60	131.60	38.96	191.60	131.60	38.96
5	184.33	124.50	40.71	186.55	133.05	46.27	187.30	133.90	47.71
50	132.00	87.00	52.32	163.15	136.40	96.29	173.97	140.47	107.26
100	64.75	64.75	64.75	138.63	138.63	138.63	153.34	153.34	153.34

Maintenance (Annual Operating Cost)

- Increases as blend percentage increases
- Decrease as blend product improves
- Decreases as level of treatment increases
- Vary according to industry
- Increases as use volume increases

Equipment (Additional Capital Investment)

- Increases as blend percentage increases based on where blending is done
- Decreases as blend product improves
- Decreases as level of treatment increases
- Varies from industry to industry depending upon existing particulate control equipment
- Increases as use volume increases

While the nature of these cost changes can be discussed, their exact magnitude is still uncertain. User firms interviewed mentioned added pump wear, nozzle clogging, and strainer clogging as examples of added maintenance and labor costs associated with waste oil combustion, but mentioned no exact cost figures. The treatment systems discussed in previous section (settling, centrifugation, vacuum distillation, and solvent extraction) would virtually eliminate these technical impacts. In situations where untreated waste oil is combusted, it appears desirable to blend it in small percentages (1 to 5 percent) with other energy sources. This would give rise to significantly lower maintenance and labor costs relative to higher blends. Where untreated waste oil is combusted in high blends (25% or larger), any fuel cost savings might be offset by the added labor and maintenance required to overhaul pumps, unclog nozzles, and clean strainers. Such maintenance involves not only the direct costs of labor and parts, but also involves the implicit costs of equipment shutdowns and of allocation of valuable labor time to something other than that for which it was intended.

The additional capital investment or equipment costs which arise from waste oil combustion are mainly in the form of installation and operation of emission control devices. The magnitude of such costs has been discussed previously. The need for control equipment is eliminated when high treated waste oil is used and is significantly lessened where low treated or untreated waste oils are blended in small percentages (less than 5 percent). However, low treated or untreated waste oil in higher blend percentages would necessitate the installation of such equipment to avoid metal particulate emissions significantly affecting air quality. In this situation it becomes a matter of comparing the fuel cost savings (difference between waste oil price and that of other fuels) to the added equipment operating expenses.

Figure 11 shows the annual operating costs (including amortized investment) for an electrostatic precipitator of 1,000,000 cfm installed at a large utility boiler or industrial facility. These costs in cents per gallon of waste oil combusted, presented in line A as a function of the annual quantities of waste oil used, are derived by dividing the annual operating cost of $300,000* by the annual quantity of waste oil fired. This figure illustrates the expected phenomenon of decreasing control equipment operating costs per gallon of waste oil fired as the annual total volume of fired waste oil increases.

Also, the fuel savings per gallon of waste oil used relative to the costs of residual oil are presented both for untreated (line C) and low-level treated (line B)waste oil. The intersection of lines A and C shows that more than two million gallons of untreated waste oil would have to be combusted annually in order for fuel savings to offset control equipment operating costs. For untreated waste oil, however, there are additional maintenance costs as discussed above which have to be considered in an overall cost-benefit analysis.

Similarly, the intersection of lines A and B shows that more than 7.0 million gallons of low-treated waste oil need to be consumed in place of residual fuel in order for fuel savings to offset control equipment operating costs. In this case, however, low-level pretreatment precludes the necessity of significant additional maintenance costs associated with waste oil combustion. Consequently, a cost-benefit analysis need only consider fuel and control equipment costs as the two primary offsetting variables.

SUPPLY FACTORS AFFECTING MARKETABILITY

The supply factors which affect marketability include location of the treatment facility, the organization of the treatment facility, and the services which the pretreater provides to the user firm.

The location of treatment facilities is of prime importance. They should be near areas where there is a high degree of waste oil generation, and high density population centers. At the same time, the distance between the facility and the purchasers of the product must also be taken into consideration given transportation costs.

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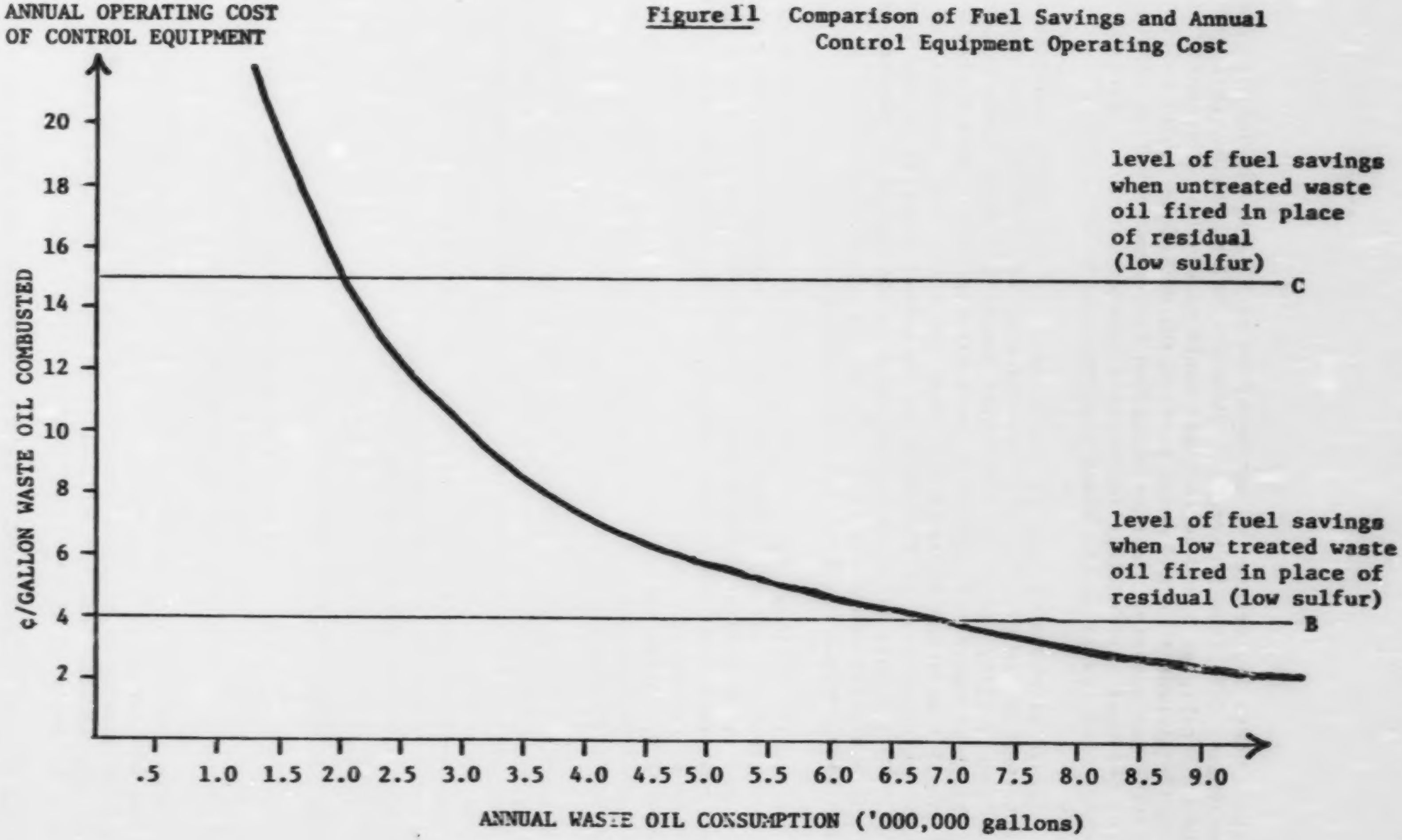
* This figure is determined by taking the approximate midpoint of the total annual cost range derived in Table 42.

Figure 11 Comparison of Fuel Savings and Annual Control Equipment Operating Cost



Another consideration is how the treatment facilities are to be established. As shown, centralized facilities represent the superior option given the economies of scale present in the treatment operation. Decentralized treatment at the plant level appear feasible only in situations of extremely high use volume.

Finally, the service to be provided by the treater will also affect the marketability. The desirability of blending the waste oil at the supply source and not at the user plant is considered desirable. Given the fact that small amounts of waste oil would be blended with large amounts of waste oil, or used with coal, it appears desirable for the waste oil product to be transported to the virgin fuel distributor, blended at these facilities, and then trucked to the user. Such a pre-blended product would add to the range of potential users.

SECTION X

FEDERAL PROCUREMENT OF PRODUCTS MADE FROM WASTE OIL

AUTOMOTIVE ENGINE LUBRICATING OILS

Federal procurement of lubricating oils for military and civilian vehicles is performed by the Defense Supply Agency. The specifications according to which most automotive lubricating oils are procured exclude those oils made from waste oils on the grounds that uniform quality of the products cannot be assured because the processes and materials (i.e., feedstocks) used in making the products vary.

Before this restriction could be removed or reconsidered, the capability of engine oils formulated from re-refined stocks to satisfactorily pass the minimum requirements for MIL-L-46152 (corresponds to API/ASTM/SAE classification of SE and CC) or MIL-L-2104C (corresponds to API/ASTM/SAE classification of CD and SC). To date there has been no evidence that re-refined oils can meet these performance levels.

The Army Coating and Chemical Laboratory, Aberdeen Proving Ground, Maryland, in 1973 purchased on the open market two motor oils from commercial re-refineries. One of the motor oils had markings on the drum indicating that it met the performance levels of MIL-L-2104C. Both re-refined oils were subjected to the qualification acceptance engine tests currently specified in both MIL-L-2104C and MIL-L-46152. The two products significantly failed to meet either specification.

The Defense Supply Agency has concluded that "any program to procure re-refined lubricating oil will require, as a preliminary step, the development of substantiating data on the general quality level of re-refined stocks and the variations in batches resulting from different waste oil sources and treatment methods." At the present time there are no specifications for automotive lubricating oils utilizing re-refined components.

Until such specifications become available federal procurement of automotive lubricating oils made from waste oils is not prudent.

OTHER LUBRICATING OILS

There are approximately 200 lubricating products procured by the Defense Supply Agency whose specifications do not preclude components made from waste oils. These include hydraulic fluids, special oils, greases, etc. It is possible to produce these products from waste oils and chemical additives but it would be difficult for those who could do so to submit bids competitive with the prices bid by those who have traditionally been the sources for federal procurement of these products. This is because the federal government's needs frequently are for fragmented quantities of products which require quite special components. Further, the places where the government needs these products are scattered around the nation, resulting in high transportation costs per unit of product. Under these circumstances a producer of lubricants from waste oils could not compete with the prices offered by those already equipped to make these lubricants unless he were located near the point of delivery for relatively large amounts of a particular product.

QUALITY ASSURANCE

Like many other products, petroleum products must conform to certain standards governing their constituents and performance. Several states have inspection programs to check compliance with state-established standards for both virgin and reprocessed petroleum products. Since the comparability of re-refined lubricating oils with their virgin counterparts has been a long-standing question, the Bureau of Mines has initiated a research program to compare several quality parameters. The limitations of most state quality inspection programs and the preliminary results of the Bureau of Mines research indicate the need to consider establishing a national program for testing all petroleum products on several quality indices.

BUREAU OF MINES RESEARCH

In March 1974 the Bureau of Mines issued the first detailed report describing the results of its re-refined lubricating oil research. While the principal objective of the research has been to develop efficient methods for reclaiming waste lubricating oils, secondary objectives have included development of simple laboratory tests to evaluate the quality of reclaimed lube oils and development of specification tests for both new and used oils to promote the marketability of recycled lubricating oil.

For the research conducted at its Bartlesville Energy Research Center, the Bureau acquired samples of re-refined oils from manufacturers, purchased at retail additional re-refined oils, produced by various methods its own re-refined oils, and compared all these with virgin oils. Comparisons were also made with used oils collected from the Bartlesville automobile fleet and from local service stations.

All the commercially purchased re-refined oil samples were straight mineral oils into which no additives had been blended. The researchers commented:

> Mineral oils generally will not stand the rigors of oxidation, provide protection to the engine from wear and corrosion, nor provide the lubricity required by today's modern automobile without the help of additives. Therefore, it was a disappointment that the commercially re-refined oils purchased locally did not contain most of the additives required to meet API service designations for late-model automobiles (SC, SD, or SE).

These same oils might qualify for an SAE 30 viscosity designation and might pass state-conducted visocity tests, but the motorist purchasing such oils for his late-model automobile might endanger his warranty and risk damage to his engine.

The Bureau researchers found that the re-refined oils they tested tended to have poor lubricity and poor oxidation stability, although the addition of additives tended to minimize these adverse characteristics. The researchers found that additive packages helped two samples of re-refined oil pass corrosion resistance and wear tests which they had previously failed.

While emphasis was placed on performance of re-refined oils, the performance of new oils should not be overlooked; two of the ten new oil samples failed the foam test performed and one of the ten failed a corrosion test.

SECTION XI

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APPENDIX A

LAND SPREADING, A CONSERVING AND NON-POLLUTING METHOD OF DISPOSING OF OILY WASTES

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INTRODUCTION

Disposal of concentrated wastes is a problem of increasing concern for public officials, industrialists, conservationists and the general public. Some of the most complex wastes are those associated with petroleum. The use of petroleum products has increased rapidly in the industralized areas of the world in the last 30 years. Though this increase has resulted in many new products and has contributed greatly to the economics of the areas involved, it has added to the problem of waste treatment and disposal. Oil and several of the chemical wastes from petroleum refining and processing are serious pollutants of surface water and land when discharged without adequate treatment and proper disposal. Extracting, transporting, refining, and selling of the petroleum products are operations with potential for polluting water. Dredging oily sludge from channels and harbors may pollute lakes and streams when the sludge is dumped back into open water. Several American refineries are reported to dispose of oily sludge on the land. This paper discusses land spreading operations for oily waste disposal by three refineries.

Use of land as a receptacle for organic wastes is an ancient practice that holds much promise for treatment and disposal of organic and some inorganic wastes in the future. Transporting digested sludge for almost 100 miles from Cleveland to strip mined areas for disposal was suggested by Wirts (1956). Economical conveyance by pipeline makes land spreading feasible for some municipalities to which land was previously unavailable. Dalton et al. (1967) calculated that land spreading of liquid digested sludge on low-productivity sandy soils after piping more than 50 miles (80.5 kilometers) would be less than half as expensive as other methods of dewatering and disposing of Chicago sludge. Templeton (1966) found land spreading at East Kilbride, Scotland, to be competitive with sea disposal or other methods and to be virtually trouble free and independent of weather conditions. Many other plants in this country and abroad continue to use land spreading even though they have installed more complicated sludge dewatering devices.

Soils have been shown to provide a high degree of physical, chemical, and biological treatment for organic wastes when the system is properly designed. Despite their demonstrated efficiency in assimilating wastes, land spreading has never been used as extensively as it could be. Although used by many petroleum refineries, oily waste disposal by land spreading has not been generally appreciated and exploited by sanitation and pollution control officials. Several reasons are apparent for the practice having failed to be used more universally. Disposal of putrescible wastes causing unfavorable public reaction; fear of pollution of surface and groundwater; using soils poorly suited to sludge assimilation; and lack of information concerning successful full-scale operations are among the reasons.

UTILIZATION OF WASTES BY SOIL MICROBES

The soil is an excellent medium for growing microbes, thus it is capable of assimilating and decomposing organic matter. Soil is described by Smith (1960) is the collection of natural bodies at the earth's surface containing living matter and supporting or capable of supporting plants. Many kinds of soils have developed through interactions of climate, living organisms, parent materials, and relief. So, while living organisms have been influential in determining the kind of soil at a given location, the resulting soil properties influence greatly the kinds and numbers of microbes living within. The soil is a complex dynamic system with continuous chemical, physical, and biological activity. Any sudden change in the environment, such as addition of oil, causes a change in soil properties, but when the cause of change is removed the soil again moves toward equilibrium with the environment.

Although soils vary from place to place in the quantity and kinds of microorganisms, most soils contain many millions or billions of microbes per gram (Waksman, 1931), the greatest number of organisms usually living near the surface. A sufficient quantity of mineral nutrients and organic matter, near-neutral pH, warm soil, and abundance of air are conditions that are favorable for reproduction and growth of microbes. Fungi are more amenable to acid soils than bacteria (Waksman, 1931). Bacteria outnumber fungi in most soils by a large margin and they reproduce much faster so it is likely that bacteria are responsible for much of the decomposition of hydrocarbons in soil.

Crude oil and the wastes that result from its processing are complex mixtures, so it is probable that few if any microbes will attack all fractions. A mixed population such as that in soils is more efficient than a single class of microbes. Petroleum hydrocarbons vary in suceptibility to decomposition. High molecular weight, viscosity, and crystallinity are properties that inhibit biological oxidation and decomposition. Straight chain medium molecular weight hydrocarbons such as kerosene and light motor oils oxidize readily, while aromatic types are more resistant.

Many studies of microbes capable of utilizing petroleum hydrocarbon have produced a list of more than 100 species and 30 genera of bacteria, actinomycetes, and fungi that attack one or more fractions of crude oil. Ellis and Adams (1961), citing Haas (1942), reported that 66% of the hydrocarbon oxidizers found in ordinary soils were Pseudomonas species. Pseudomonas can grow under a wide range of conditions and with very little food. They are prevalent in population where petroleum hydrocarbons are available and in activated sludge.

There is much evidence, other than that from research studies, to attest to the capacity of soil microbes to assimilate hydrocarbons. Peculiar accumulations of organic matter near the soil surface have been shown to be associated with gas seeps and petroleum deposits. The organic deposits, called "paraffin dirt" because of their waxy appearance, consist of cells of hydrocarbon utilizing microbes, and colloidal organic material produced by them, and are used as a tool in prospecting for petroleum (Davis, 1967).

Decomposition of the asphalt coating used to protect some underground pipes from corrosion is credited to microbes which have been found to be present in usually large numbers around such pipes. Asphalt used in combination with wheat straw by conservationists and engineers to mulch ditch banks is decomposed at about the same rate as the straw.

Seepages of oil and natural gas have doubtless existed in nature for centuries without producing lakes of oil or high hydrocarbon accumulations in the atmosphere. Microbial assimilation in the soil is postulated (Ellis and Adams, 1961) to be the cause of this phenonenon.

The three land spreading operations described in this paper illustrate different techniques of disposing of oily sludge by land spreading.

LAND DISPOSAL PRACTICES

The Humble Oil Company, Baytown, near Houston, Texas has disposed of oily sludge from gravity oil-water separators by spreading on land for about 16 years. The sludge is pumped from the bottom of API oil-water separators into one of two storage pits where it remains for one to two years. When a put is full it is dewatered by decarding and the sludge removed by a clamshell to dump trucks and hauled to adjacent grassland where it is dumped and spread with a bulldozer. After partial drying the sludge is incorporated into the soil by disking with a large heavy-duty disk and a crawler type tractor. A single disking is used to mix soil and sludge and stimulate biological decomposition.

The land consists of clay soils. Tests of soil samples taken prior to the beginning of sludge spreading indicated a pH of 4.4 to 4.8 in the topsoil. The content of available nitrogen was medium, and available phosphorus was low. Two tons of agricultural ground limestone, 50 pounds of nitrogen per acre (56Kg/Ha), and 60 pounds of phosphorus per acre (67Kg/Ha) were applied once, but the application was not repeated. No farther soil testing was done. The purpose of fertilizing and liming was to produce a favorable medium for microbial activity and not to fertilize the grass.

An average API oil-water separator sludge consisted of an emulsion with about 20% hydrocarbon, 25% solids, and 55% water. The solids come from unclarified river water, storm water runoff, and precipitates in the system and weight of the emulsion so that it is heavier than water. The sludge is spread to a thickness of about four to five inches (10 to 12.5 cm). Thus about one inch (2.5 cm) of hydrocarbons, equivalent to about 100 tons per acre (110 metric tons/Ha) is applied.

By the time that the sludge is dry enough to work into the soil, the grass has started to grow. It is growing noticably in three to four months and has usually established a normal grass cover within a year.

Shell Oil Company's refinery at Houston, Texas has successfully used an intensive land spreading system for disposing of nearly all of its petroleum sludges and stable emulsions from tank bottoms, oil-water separators, sewer boxes, and ship ballast water since 1961. The tract of land used consists of approximately seven acres (2.83 hectares). It is divided into four nearly equal sections by built-up roads. The characteristics of the soils in the disposal area have been altered by man's activities, which include the dredging of the Houston ship channel and construction of the disposal area, but H.V. Geib et al. (1928) described the natural soils in the area as clayey or fine textured, naturally poorly drained, and neutral or calcareous in reaction.

The climate at Houston, Texas is characterized by hot summers and mild winters. The average July temperature is 83°F (28°C) and the average for January is 54°F (12°C). The average date of the last killing frost in the winter is February 10 and the first one in the fall is December 8. The average growing season is 201 days. The maximum temperature of record was 108°F (42°C) and the minimum was 5°F (-15°C). Forty-five inches (112 cm) of precipitation, almost evenly distributed throughout the year, is normal (Yearbook of Agriculture, 1941).

A section is prepared to receive sludge by grading it to a very gentle slope and constructing 20 inch (50 cm) high terrace ridges to distribute sludge evenly. The lowest point in each section is equipped with a pipe underdrain which leads to a small oil trap for gravity separation of entrained of before the water is discharged into the stream. Oil is retrieved for further treatment or is returned to the land.

After a section has been properly graded to assure even distribution, oily sludge and emulsions are brought from the refinery by vacuum truck and discharged into the enclosed section where it spreads to a depth of about six inches (15 cm). The sludge consists primarily of oily solids, but it may contain wax, entrapped water, and pockets of oil. The oil is recovered by vacuum truck for return to the refinery. After drainage of excess water and removal of free oil, a bulldozer is used to mix the sludge with about six inches (15 cm) of soil and stir the mixture to improve aeration and accelerate drainage. The stiring is repeated from two to four times each month until the soil returns to a brown friable condition indicating that biological oxidation has progressed for enough for oil to be added again. Stirring is an important part of the process as it keeps the mixture aerobic and disperses hydrocarbon molecules making them ore readily available for microbial attack. The original mixture of equal volumes of oil and sludge is very oily and unpromising. Four sections are used so that as one is being filled another is prepared to receive sludge, and two others are decomposing the oils.

The time required to decompose the sludge varies from three to nine months with some of the most important determining factors being moisture content and temperature of the soil and the types of hydrocarbons applied. Wet soil has been observed to inhibit consumption of the sludge. Although a record of soil temperatures is not available, the temperature of a nearby pond averaged 75°F (23°C) with winter average being 42°F (5.5°C) and the summer being 99°F (37°C). Beerstecher (1954) gave 86°F (30°C) as optimum temperature for incubation of most hydrocarbon-oxidizing organisms.

Two types of hydrocarbons observed to be particularly resistant to microbial decomposition are paraffin waxes which form hard cakes that are difficult to mix with the soil and high molecular weight polyaromatic material. However, even these resistant materials are eventually decomposed.

At the beginning of the land disposal operation, the refinery conducted a pilot study to determine the rate at which hydrocarbons would decompose. Two open boxes containing 51 (23.3 Kg) and 56 pounds (25.4 Kg) of soil respectively were treated with oily sludge at the land disposal area. The soil and oil were mixed at irregular intervals and the oil content determined. The rate of decomposition varied from 5 to 60 pounds (80 to 960 mg/cc) per cubic foot of soil per month. A rapid rate of decomposition occurred with as much as 23% of oil by weight added to the soil. Though at a slower rate, oxidation did continue through the colder months of the year.

MICROBIOLOGICAL STUDIES

Although numerous investigators have reported the use of petroleum hydrocarbons for food by various microbes, not much information was available to indicate which genera would be most likely to increase in numbers and activity in the presence of oily waste in a warm humid climate such as in southeastern Texas.

In November, 1968, soil samples were taken for bioassay from three of the sections of the Shell Oil Company disposal area and from the relatively undisturbed soil outside. Samples one and two were from a relatively undisturbed soil outside of the disposal area. Three and four were from a section where oil was about mid-way through the decomposition phase of the cycle. Five and six represent an advanced stage of decomposition, and seven and eight were from a section that has recently received oil.

Samples were collected by a sterile sampling technique. One hundred twenty milliliter capacity sterile metal cans were pressed into the soil to obtain the sample. Plastic gloves and wood spatulas were used to protect the sample from contamination in handling.

BACTERIA

In the study of soils and oil-treated soils, agar pour plates were made of soil dilutions ranging from 10^{-1} to 10^{-8} in pH 7.2 buffer water. The numbers of bacteria per gram of soil were determined after three days' incubation at room temperature, for petri plates containing 30 to 300 colonies. The plating medium contained peptone, glycerol, magnesium chloride, potassium sulfate agar, and distilled water (King A medium). Colonies were chosen at random from the lowest count plates with the number of colonies that could be characterized by the laboratory. Only aerobic species of bacteria were studied because many investigators have reported that anaerobes are inefficient decomposers of hydrocarbons.

Table 1 lists the types of bacteria found in the soil samples. *Pseudomonas stutzeri* was the species that showed the most rapid growth after application of the oily waste. The numbers of bacteria increased as the oil was decomposed until the food source decreased. Genera such as *Bacillus*, *Streptomyces*, *Achromobacter*, and *Flavobacter*, present in the untreated soil, did not increase as much in the oil-treated soil as the *Pseudomonas* species did, and were not even detected in samples three and four where the greatest number of bacteria was found. There were fewer bacteria per gram of oil-saturated soil indicating a probable toxic effect of volatile constituents in the oil.

FUNGI

Very little information is available in the literature concerning the ability of fungi to degrade wastes of the petroleum industry. As a result of observing molds growing in a stream into which oil wastes from a refinery in west central Ohio were discharged, as well as interest in the availability to fungi of hydrocarbon as a seurce of nutrients,

TABLE 1

Aerobic Bacteria Found in Oily Sludge Treated Soil at the Shell Company Refinery

Species and Genera	Achromobacter sp.*	Bacillus sp.	Flavobacter sp.*	Pseudomonas stutzeri	Pseudomonas sp.*	Streptomyces sp.*	Unknown sp.*
Area 1, Untreated soil, bacterial count/gm soil 4.25x107							
Number of strains	5	6	1		3	10	
% of total	20	24	4		12	40	
Area 2, Sludge treated soil, oil midway in oxidation, bacterial count/gm soil 6.5x10^7							
Number of strains				21	4		
% of total				84	16		
Area 3, Sludge treated soil, oil in advanced stage of oxidation bacterial count/gm soil 3.5x10^7							
Number of strains							
% of total	12		12	68	8		
Area 4, Sludge treated soil, very oily, bacterial count/gm oil 1.5x10^5							
Number of strains			8	4	10	1	2
% of total			32	16	40	4	8

*Species recognized but not identified were combined.

Cooke (1957) substituted S.A.E. 20 motor oil for glucose in a nutrition experiment in shaken flask culture. It was found that the ratio of growth in the motor oil to that in a solution containing glucose was 7.58 in the case of *Penicillium lilacinum*, 6.18 in *Geotrichum candidum*, 3.96 in *Rhinocladiella marsonii* and 2.49 in *Fusarium aquaeductuum*, all common fungi of polluted waters and sewages; while in other common species of molds these ratios were only between 0.50 and 0.75 in the cases of *Fusarium oxysporum*, *Penicillium melinii*, *P. ochro-chloron*, *Aureobasidium pullulans*, and *Trichoderma viride sensu lato*.

Crosby, Rudoffs and Heukelekian (1954) were more interested in the control of slime growths which appears in various areas in oil refineries. However, they observed that in addition to several types of bacteria and blue green algae, flamentous fungi were present. They noted that as a result of their ability to adsorb oils such slime-forming organisms might be of potential significance in removing polluting substances from waste discharges from such plants. More recently, it has been noted that jet engine fuel tanks contain contaminating organisms.

Reese, Cravetz and Mandels (1955) tested the activity of 358 cultures of fungi on coconut oil and a castor oil derivative, methyl-acetyl-ricinoleate. The medium used included 0.5 gm of oil in 50 ml nutrient solution using 1.0g NH_4NO_3, 1.36g KH_2PO_4, 0.2 g $MgSO_4.7H_2O$, 0.1 g Difco yeast extract, in a liter of distilled water with the pH adjusted to 6.4. Ten of the species reported in the following study were included among the strains tested. Best results were obtained with *Aspergillus terreus* of this group. Others producing significant amounts of growth in this experiment were: *A. flavus*, *A. fumigatus*, *A. niger*, *Penicillium lilacinum*, *P. funiculosum*, *Trichoderma viride sersu lato*, *Myrothecium verrucaria*, *Aspergillus flovipes* and *Humicola fuscoatra*.

Coursey and Eggins (1961) studied microorganisms responsible for the spoilage of palm oil during storage. Of the 15 species of filamentous fungi they found, strains of at least one of those to be reported here were tested for lipolytic activity. *Aspergillus niger* was strongly lipolytic, while *Curcularia lunata* and *Aureobasidium pullulars* (*Torula nigra*) were present amont the species isolated.

Nuus et al. (1968) tested a wide range of fungi to determine their ability to assimlate a series of hydrocarbon fractions. The orders *mucorales* and *moniliales* were found to provide the larges number of hydrocarbon-using classes. *Aspergillus* and *Penicillium* are genera which provide many strains that assimilate hydrocarbons.

METHODS USED IN FUNGAL EXAMINATION

The samples from Shell Oil Company refinery were plated, using pour plates, in dilutions of 1:100, 1:1000, and 1:10,000, in neopeptone-dextrose agar, and neopetone-dextrose-rose bengal agar, in all cases using tetracycline as a bacterial inhibitor. Dilutions of the samples were prepared in distilled water using a rotary shaker at about 150 oscillations per minute for breaking up and dispersing the soil particles in the sample. In the case of samples 3, 4, 5 and 6, approximately 75% of the 15 ml sample remained balled up in water resistant oil during this process so that probably only about 1/4 of the amount of soil taken was actually sampled.

Table 2 lists the corrected, estimated numbers of colonies of fungi recovered from the samples. In calculating oven dry weights it was assumed that, like many samples of soils, these samples were approximately 67% dry material, 33% water. In the case of soils permeated by oil, this value may be too high. In the case of four samples, where incomplete dispersion resulted from shaking, the numbers of colonies obtained may have been low.

TABLE 2

Colonies of fungi recovered from oil soaked soils

Sample	Medium	Dilution	Avg. No. colonies per pair plates	Avg. No. colonies per ml sample	Approx. Avg. No colonies per gm "oven dry weight"	Average
Area 1						
1	RB*	1:10,000	40	400,000	1,300,000	
2	RB	1:10,000	11	100,000	380,000	840,000
Area 2						
3	RB	1:10,000	7	70,000	380,000	
4	RB	1:10,000	17	170,000	570,000	1,900,000*
Area 3						
5	ND	1:10,000	21.5	215,000	710,000	
6	ND	1:10,000	6	60,000	200,000	1,840,000*
Area 4						
7	ND	1:1,000	2.5	2,500	840	
8	ND	1:1,000	6	6,000	2,000	1,400

Table 3 lists the species of fungi recovered from the four areas sampled in Table 3, data from pairs of samples have been composited.

Results of a preliminary study such as this indicate that fungi, both filamentous and yeast-like, are present in large numbers in soils subjected to receipt of oil wastes, especially where these soils and wastes are thoroughly mixed (aerated) periodically. While in a lagoon area to which oil wastes have been freshly applied the fungus count is low, as in samples 7 and 8, as the mixing and aerating process proceeds the count rises rapidly, reaching more than twice as many colonies in the treatment area as in the presurably undisturbed area nearby, if a correction is made for incomplete homogenization of the sample in water.

Table 3 lists the species of fungi recovered from the four area sampled In Table 3, data from pairs of samples have been compoisted.

TABLE 3

Species of fungi recovered from aoil waste didposal samples

Species	Area			
	1	2	3	4
Unidentified molds	x	x	x	x
Aspergillus terreus	x	x	x	x
Penicillium lilacinum	x	x	x	x
Curvularia lunata	x		x	
Aspergillus niger	x		x	
Trichoderma viride	x		x	
Fusarium spp.	x		x	
Monosporium apiospermum	x			x
Mucor spp.	x			
Penicillium janthinellum	x			
Aspergillus flavus	x			
Cylindrocarpon destruens	x			
Myrothecium verrucaria	x			
Fusarium oxysporum	x			
Humicola grisea	x			
Aspergillus fumigatus		x	x	x
Rhodotorula aurantiaca		x	x	x
Diheterospora chlamydospora		x	x	x
White yeast spp.		x	x	x
Candida tropicalis		x		
Rhodotorula sp.		x		
Monascus sp.			x	x
Aspergillus flavipes			x	
Aspergillus sp.			x	
Torulopsis dattila			x	
Candida guilliermondi			x	
Aspergillus candidus			x	
Penicillium funiculosum			x	
Curvularia geniculata			x	
Humicola fuscoatra				x
Penicillium variable				x
Leotographium sp.				x
Stilbella sp.				x
Total species--34				
Total species from each sample	12-11	7-6	11-13	10-9
Total species from each area	16	10	19	14

On the basis of this preliminary study it appears that there are species of fungi, strains of which can readily adapt to conditions of the soil waste disposal area from which the samples were obtained. At least five species of filamentous fungi and one red yeast are common to all areas in which waste oil sludges are treated in this area near Houston, Texas. There is no reason to believe that similar populations are not present elsewhere.

The Marathon Oil Company at Robinson, Illinois, used land spreading to dispose of oily sludge from two lagoons in 1969. In contrast to the other disposal operations, sludge was spread only once. The lagoons which had been used as settling basins or clarifiers following a trickling filter in their old waste treatment system, were cleaned in preparation for construction of a new treatment plant. The sludge accumulated over a period of five years, had an estimated average composition of 40% water, 25% ash, and 35% oil.

The land used for disposal purposes is owned by the refinery and is located adjacent to it. The soils are derived from loess mantled glacial till. They have a silt koam surface and a dense impermeable clay suboil. They are nearly level, poorly drained, and strongly acid.

The climate at Robinson, Illinois, is cooler than at Houston, Texas, with an average January temperature of 32°F (0°C). The average for July is 76°F (24°C). The highest recorded temperature is 108°F (42°C), and the lowest is --18"F (-28°C). The average growing season of 182 days results from the first killing frost on October 18 and the last on April 19. Forty-two inches (105 cm) of precipitation are distributed almost evenly throughout the year (Yearbook of Agriculture, 1941).

The disposal procedure consisted of removing the sludge in May from lagoons with a clamshell, loading it into a dump truck, hauling to the field, and spreading. After a few days of drying the sludge was mixed with the soil to a depth of about 18 inches (45 cm) by disking. Two applications of sludge of about two inches (5 cm) were applied before disking.

A rainstorm occurring soon after some of the sludge was applied, and before cultivation, resulted in erosion of the oily sludge and deposition of it in a catch basin or small lake on refinery property. It was of sufficient magnitude to kill some fish in the lake. This incident illustrates the potential for water pollution from land spreading.

Soil samples were collected from the disposal area for assay of the bacteriological population in November, 1969. Samples one and two were taken from the last part of the field to receive sludge. Samples three and four were from a part of the field that received sludge first and was representative of the poorest drainage. Samples five and six were from an area of similar soils to the site of samples three and four, but no sludge had been applied. The microbial population may, however, have been influenced by the proximity of the refinery. Table 4 shows that the types of bacterial population in the untreated soil are different from those that have been in contact with the oily waste for about five months. The presence of hydrocarbons caused the inevitable growth of those types of bacteria and fungi which are most efficient at using the hydrocarbons for a food source and at growing under the environmental conditions produced by the addition of oily wastes. The principal hydrocarbon users are gram-negative, rod-shaped bacteria. The bioassay of the samples indicates that *Pseudomonas* species, particularly *Pseudomonas stutzeri*, made the greatest growth after the addition of oil and as a result Pseudomonads comprised over half of the population of the samples. Pseudomonads were not detected in the samples from the non-oil treated soil.

DISCUSSION

Many investigators have shown that microorganisms occurring ubiquitously in soils will attack petroleum hydrocarbons when they are added to soil. Unfortunately, the process is too show for effective disposal of oily sludge or reclamation of soil after oil spills or leaks without some cultural practice to accelerate decomposition. Conditions favoring growth of most higher plants are generally favorable for aerobic microbes, so management of a disposal area can be patterned after a successful crop production enterprise. Anaerobic decomposition is very slow, and adding a large amount of oil to soil creates anaerobic conditions if no precautions are taken to aerate the soil. Oil not only occupies the pore space, thus excluding air from the soil, but it also greatly increases the oxygen demand for its own oxidation. Disking was the method first used to stir and aerate the soil by the three refineries, but the Shell refinery found that the disk compacted soil and interfered with aeration. The bulldozer was substituted and was found to leave the soil more loose and open, thus resulting in faster dewatering and better aeration. The oil-soil mixture is rolled by the blade much as oil dressing is rolled with soil for use on some secondary roads. Some of the hydrocarbons, particularly waxes and heavier oils, are more resistant to decomposition, partially because less surface is exposed to microbial attack. Dispersion of these by intimate mixing with soil particles apparently allows the organisms to attack and decompose these fractions faster. Mineral nutrients, particularly nitrogen and phosphorus, are important for microbial growth and activity. Although in none of the disposal operations studied was fertilization a regular practice, it appears likely that addition of an appropriate fertilizer would accelerate oxidation. Moisture is important to the microbes, but excess moisture, by impeding aeration, may be a limiting factor for microbial activity. Tile or surface drains may be needed for some soils.

Several changes in soil are reported to take place after introduction of hydrocarbons (Ellis and Adams, 1961). Investigators have reported a marked increase in organic matter, total carbon, and nitrogen. Davis (1952) reported natural deposits called "paraffin dirt" were composed of the residue of microbial cells which had utilized methane gas at the site of seepage. An analysis of the deposit showed that it contained 17.6% organic carbon and 1.2% total nitrogen. The amounts found in most natural soils are much lower. Plice (1948), while studying the effects of crude petroleum on soil fertility, found soil with organic matter content of 12.4% and nitrogen content of 0.8% near a gas leak, but at a distance of two feet (60 cm) the soil contained only 0.52% organic matter and 0.03% nitrogen.

TABLE 4

Aerobic Bacteria Found in Oily Sludge Disposal Area and in Adjacent Soil at the Marathon Oil Company Refinery at Robinso, Illinois

Species and Genera	Barcillus sp.	Streptomyces sp.	Alcaligenes sp.	Pesudomonas stuzeri	Sarcina sp.	Archromobacter sp.	Flavobacter sp.	Pseudomonas sp. (black pigment)	Pseudomonas sp. B	Pseudomonas sp. Cy	Unknown
Soil without sludge, samples #5 and 6, bacterial count/gm of soil 1.05x108											
Number of Strains	11	4	9								1
% of total	44	16	36								4
Soil treated with sludge, samples 1 and 2, bacterial count/gm soil 1.79x108											
Number of strains	2		1	12	2	4	2	2			
% of total	8		4	48	8	16	8	8			
Soil treated with sludge, samples 3 and 4 bacterial count/gm soil 1.03x10											
Number of strains	3	1	4	3					5	5	3
% of total	12	4	16	12					20	20	12

Oil has the effect of deflocculating surface soils when it is applied to them. However, the eventual effect is to imporve the soil tilth by increasing the organic matter content.

Large oil applications are often toxic to plants. The volatile fractions, which have great penetrating power, enter plants and seeds and have a narcotic effect on all living organisms. Reduction of manganese to the manganous form by the lowered oxidation-reduction potential caused by addition of oil creates toxicity also, but Plice (1948) reported that most of the damage to plants was caused by mechanical obstruction which prevented the plant from obtaining sufficient mositure and air.

Soil productivity may be enhanced by high application of oil. Plice (1948) observed that petroleum additions of 0.5 to 1% by weight produced more luxuriant plants than those growing on check plots where no oil was added. He also noted that soils saturated with oil to a depth of more than four feet eventually returned to a productive state. One such soil remained barren and boggy for a few years, but after seven years was observed to be more productive than adjacent unaffected soil. Ellis and Adams (1961) cited the work of Carr (1919) in which he found that soybean growth was improved by adding a small amount of oil. Damage to some plants has been estimated to begin at more than 1 Kg/square meter of soil (Schwendinger, 1968). A number of organic acids from petroleum industry wastes have been shown to stimulate plant growth. Weak solutions of napthenic acid increased significantly root length of cotton, cucumbers, onions, and winter wheat (Husinov, 1961).

Deep, fire-textured soils were used for the disposal sites. Oil is known to adhere to such soils and move but little into them, thus eliminating danger of groundwater pollution, if oil is added judiciously. Only indiscriminate, heavy additions of oil to coarse, porous, or shallow soils would be expected to cause such pollution.

The use of land spreading to dispose of oil spills collected on beaches has been proposed (R. Stone, Santa Monica, California, personal communication, 1969). Air movement through the sandy soil behind beaches might be enhanced by tidal changes in the groundwater levels and this would favor rapid decomposition of oil and any straw used to help collection of the oil. As in all other land disposal practices, it will be imperative to avoid overdosing and the creation of tightly packed impervious lamps of oil and soil. When straw is used, additional supplies of nitrogen may be necessary because of the high nitrogen requirement for decomposition of the straw.

CONCLUSIONS

1. Soil microbes can oxidize and decompose a large quantity of petroleum hydrocarbons under a wide range of soil and environmental conditions.

2. Land spreading is an economical and comparatively foolproof method of disposing of oily wastes.
3. Although large additions of oil may create toxic conditions for plants, the eventual effect upon soil is to improve physical and chemical properties by increasing organic matter and nitrogen content, decreasing volume weight and increasing porosity and moisture holding capacity.
4. Natural biochemical decomposition of oil in soil may be accelerated by judicious use of lime and fertilizer, artificial drainage, and tillage.
5. Microbiological degradation of oily wastes takes place under a wide range of temperature, but oxidation is faster in warm or hot climates than it is in cold.

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APPENDIX B

THE EUROPEAN COMMUNITY EXPERIENCE ON WASTE OILS

Two European countries, France and Italy, encourage re-refining of waste oils by granting tax preferences for re-refined products. Two other countries, Germany and Denmark, have laws governing collection and disposal of waste oils. The Commission of the European Economic Community has proposed to the Council of Ministers a directive concerning disposal of waste oils which, if adopted, would apply to all members of the Community. Bills are pending in France and the Netherlands to regulate the disposal of waste oils. This Appendix summarizes the provisions of these laws and bills.

France

Each ton of oil products in France is subject to a tax of 270 Francs (approximately $54.50). Re-refined oil products are exempted from this tax. As a result re-refined products cost 400-450 Francs/ton, compared to 650-700 Francs/ton for new oil products from the re-refineries. France bases its tax preferences for re-refined products on several policies; protection of re-refining businesses; prevention of fire or pollution from improper disposal; and provision of at least some lubricating oil supplies during periods of internal or external supply shortages.

There are several private companies in Franch which collect and re-refine waste oils. The largest is the Societe pour le Remassage et la Regeneration des Huiles Usagees. Its shares are owned equally by refiners and re-refiners. The company operates on the basis of an agreement between the refiners and the re-refiners which limits the amount of oil re-refined to 50,000 tons. Any more than this collected by the company is delivered to the refineries where it is burned. The re-refined products are purchased largely by the French government.

Italy

Refineries in Italy must have permits to operate and some of the refineries are authorized to re-refine waste oils as well as refine crude oils. Re-refining is encouraged by a generous tax preference provision applicable to re-refined products. The tax is 25 percent of that levied on fresh oil products and amounts to a preference of between 93,000-117,500 Lire/Ton (approximately $153.40-$194.00/ton) of re-refined product, depending on the quality of the product.

Italy, too, wished to protect its re-refining industry and to be free of total dependence on shipments of foreign crude oils in times of crisis. Prices for re-refined products are about 35 percent lower than for comparable fresh oil products and approximately 20 percent of the lubricating oil market is occupied by re-refined products.

The Federal Republic of Germany

After World War II Germany granted tax preferences, and in 1964 direct subsidies, to support re-refining in order to conserve foreign exchange, preserve a range of prices for lubricating oils, protect the re-refining industry and prevent water pollution. In 1969 a new law went into effect which converted the source of support for waste oil collection and disposal from the public treasury to a single-purpose fund created by a special assessment on lubricating oils payable prior to sale by all who produce or import them. From this fund payments are made to private or public entities which collect waste oils and dispose of them by re-refining or incineration in accordance with the provisions of a contract with the federal office for trade and industry.

The obligations based on the law which are imposed on the collection and disposal firms by their contracts require that:

1) amounts of used mineral oils and fluid mineral oil products over 200 liters within a district defined in the contract be picked up;
2) collection of these oils be at no cost to the source unless they contain more than 10 percent foreign matter, in which case the firm may charge in accordance with a fee schedule;
3) suitable containers be provided to persons who have less than 200 liters, for collection later;
4) waste oils be disposed of harmlessly, i.e., without causing water, soil or air pollution, either by re-refining or incineration;
5) the firms install devices which will enable the federal office to monitor the amounts of oil disposed of;
6) applications by the firms for the fixed-rate payments for disposal be made each month for the amount of oils disposed of the preceding month;
7) payments received for disposal by producing re-refined products which products are later exported to nations which are members of the European Economic Community be repaid to the federal office and that the firms give notice to that office of such exports;
8) the firms keep records of their costs and make these records and all other information relevant to disposal of used oils available to the federal office;
9) firms picking up used oils with more than 10 percent foreign matter give receipts for these oils to their sources.

Persons who generate more than 500 kilograms annually of used oils which would not be picked up for free (i.e., which contain more than 10 percent foreign matter) must keep records of how they dispose of their oils. Firms which collect these oils must keep similar records, in addition to providing the receipts mentioned above in No. 9. These persons and firms must make their records available to officials any time they are requested to do so.

The federal office has arranged for all areas of Germany to be covered in the contracts of at least two contractors in order to promote competition among the contractors.

Denmark

The basic scheme adopted by Denmark's May 1972 law for the control of waste oil pollution consists of establishing waste oil delivery points, arranged on a local level, to which waste oil can be delivered for final disposal. Local governments are required by law to provide such facilities, either individually or in common with neighboring localities. Waste oil as used in the law is any oil which is intended for a use other than a use for which it is suited and, conversely, disposal is the use of the oil for a purpose other than one for which it is suited. In testing for suitability, consideration is given to whether the use is more polluting than the normal use of the original product.

Although the law imposes a duty on all persons to store, transport and dispose of waste oil in a safe and non-polluting manner, commercial enterprises which generate less than 300 liters of waste lubricating oil per year are exempt from the duty to deliver to the public disposal facility. Enterprises which do deliver are required to give reports to the locality giving the nature, composition and volume of the waste oils. Persons required by law to deliver waste oil to the public collection points may be charged a fee set by the locality based on the cost of the collection and disposal program. Persons not required to deliver (individuals, non-commercial sources and businesses producing less than 300 liters of waste lubricating oils annually) have the right to deliver their waste oils for free.

As an alternative to the basic disposal offered by the locality, an enterprise subject to the reporting and delivery requirements may be exempted from the delivery obligation if it can establish that its waste oil is being disposed of in a safe manner, which is usually delivery to facilities having the capability to reprocess or destroy the waste oil.

The law does not currently apply to Greenland or the Faeroe Islands but can be put into effect by the Minister for Greenland or by royal decree, respectively. It is anticipated that the law will soon be extended to other waste products, especially chemicals, as technology for disposal improves.

Fines and imprisonment are authorized for violations of the law or regulations.

In at least one case the exemption provisions have been utilized by an industry trade association. Two trade groups of the petroleum industry have made an arrangement for the pick-up of waste lubricating oil at gas stations and work shops operated by customers of their members. When a station has a full storage tank it notifies its supplier, who in turn arranges for a tank truck to pick up the waste oil and deliver it to one of two refineries depending on the part of the country. The service is free and apparently is financed by the value of the re-refinable lubricating oils.

The Danish scheme carefully keeps the government out of the specific technology of disposal, limiting its role rather to enforcement of the duty to dispose of the waste oil in a safe, non-polluting manner, and to provision of facilities so that everyone has a simple and convenient method available for disposal of the oil.

European Economic Community

The directive proposed for adoption by the Council of Ministers of the E.E.C. in accordance with Article 100 of the Treaty of Rome would prohibit disposal of used mineral oils by any means other than re-using them, i.e., other than incineration or reprocessing. The member nations of the E.E.C. would be directed to take all measures necessary to assure that disposal of used oils into surface, ground or coastal waters, or into sewers would be prohibited, as would disposal onto land of the used oils or wastes from reprocessing them. Air pollution would have to be limited to that which is unavoidable under the state of the art of incineration.

The member nations would also be required to assure that waste oils were collected and harmlessly disposed of. Collection and disposal enterprises would have to be licensed after an examination of their facilities and would have to comply with the conditions imposed in the license.

If collection and disposal were not profitable in a certain area the member nations would have to require one or more firms to collect, perhaps by designating mandatory collection districts. The directive would authorize member nations to reimburse firms upon whom an obligation to collect and dispose was imposed for the average annual costs of similar disposal firms not covered by sale of the re-refined products or of the energy from incineration, including a reasonable profit. The costs of these reimbursements would be financed by an assessment on these products which later become used oils.

A person having waste oils which he cannot dispose of harmlessly himself would be required to surrender it for disposal by a licensed enterprise. Those having waste oils with more than a certain percentage of foreign matter would have to store them separately from other waste oils. The collection and disposal firms would be obligated to treat the wastes so as not to cause avoidable water, air, or soil pollution. All firms generating, collecting or disposing of more than 200 liters of used oils per year would have to keep records of the quantities, kinds, origin, and distination of oils for all transactions involving surrendering, collecting or disposal of these oils. Dates would also have to be recorded.

The directive provides that enterprises disposing of used oils should provide information to the governments of the member nations and that these governments would have the right to inspect these enterprises periodically.

The Netherlands

The bill introduced in the fall of 1973 in the Netherlands would prohibit disposing of used oils on land. (The present water law prohibits discharging them into waterways.) The bill would also prohibit giving used oils to anyone except a person licensed to collect and then store, treat, transform or destroy them. Each party involved in a transaction transferring waste oils would have to notify the Ministry of Health and Environmental Protection of the date of the transaction; the name and address of the recipient; the nature, composition and quantity of the oils transferred; the means and place of delivery; and the name and address of any third party employed to convey the oil to the recipient.

The bill would authorize the Ministry to condition the granting of a license to collect waste oils on the requirement that the licensee pick up in defined areas only and give the waste oils only to disposal facilities named in the license. Licenses to dispose of waste oils would be conditioned with reciprocal requirements to accept waste oils only from named collectors. The government would issue the licenses to collect and to dispose so as to cover the entire country and to assure a balance between supply of and demand for waste oils across the country.

The bill provides that a special assessment on lubricating and hydraulic oils levied prior to sale would be imposed to pay for the expenses of implementing the law. It also provides for the creation of a commission to advise the Ministry on the implementation of the law.

EUROPEAN ECONOMIC COMMUNITY

The Commission of the European Economic Community has been promoting a harmonization of the member nations laws on the taxation of oil and the disposal of oil since 1963. The department concerned with dismantling impediments to free and equal competitive conditions among the member nations has sought to coordinate the various kinds of legal provisions affecting used oil disposal in E.E.C. countries: tax preferences for products from re-refined oil in Italy and France; tax preferences, then subsidies, now specially-funded compensation for re-refineries in the Federal Republic of Germany (compensation for incineration in the FRG now, too); prohibitions, or simply no regulation at all, in several countries.

The Commission became involved when the Netherlands objected after the Federal Republic of Germany enacted a law, effective January 1, 1964, granting a subsidy of DM 22.90 per 100 kilograms of re-refined oils. This subsidy, which replaced a tax preference of DM 15/100 kg. re-refined products, would distort competition and discourage trade between the member nations of the E.E.C., argued the Netherlands. The Commission's initial investigation revealed that France and Italy granted tax preferences for re-refined products (with the same effect as the German subsidy) and that the Netherlands itself did not in practice collect the oil tax applicable to the products of re-refineries. The discussions and information generated by the Commission over the next few years indicated that a satisfactory solution would be difficult without more technical data.

As a result, in October 1966, the representatives of the member nations agreed that a technical person should be asked to prepare a report. J. J. Hopmans, former director of the Netherlands National Institute of Wastewater Treatment, was granted a contract to report on the current technical possibilities of disposing of used oil without water pollution, the costs, advantages and disadvantages of these possibilities, and their effect on the competition in the lubricating oils market. The report was presented in April 1968 and contained recommendations for a Common Market-wide means of regulating the collection and disposal of used oil.

Hopmans suggested that all forms of direct state support for regenerating and burning enterprises (whether via tax preferences or subsidies) be abolished, that regional organizations be created with the task of collecting and supervising the harmless disposal of used oil and the by-products of regenerating it, and that the costs of these organizations be covered by the introduction of an assessment (an "oil penny") on lubricating substances which become used oils. Hopmans recognized that this suggested framework would have to be worked out in light of the existing legal, technical, administrative and geographical situations. He suggested that levying the assessment on lubricating substances in conjunction with the taxes on these oil products would be the easiest and cheapest.

He considered that the collection organizations should be public corporations, like the West German Bilgenentwaesserungsverband, with bylaws setting forth duties, powers, organization and procedures. Their boards of directors should include, in addition to government officials from the responsible departments, representatives of all interests concerned with used oil -- re-refiners, those who burn used oils, the large oil firms, used oil collectors, industries that produce significant amounts of used oils -- as a means of promoting cooperation. Their staffs should include mechanics and chemists experienced in oil production who could advise possessors and collectors of used oils when questions or problems arose. So that the organizations and their advice would be trusted, they should not, Hopmans suggested, be given any powers to enforce or punish. Rather, they should help solve problems peacefully and refer recalcitrant persons to the proper state authorities.

For some reason the Commission did not forward any recommendations on used oil to the Council of Europe after the report was submitted, perhaps because its chief executives decided that the distortion of competition in the market wasn't so serious, perhaps in part because the staff person who had been chiefly concerned about waste oil left the Commission shortly after the Hopmans report was submitted. The Commission has written that "discussions were held with national experts in the light of this report in 1968, but unfortunately failed to open the way towards this Community solution because the Member States did not all attach the same importance to waste oil disposal and differed fairly widely on the appropriate arrangements."

Several inquiries were sent to the Commission by members of the European Parliament in 1970, '71 and '73 concerning the announced harmonization of member nations' regulations of used oil disposal and the alleged inequities resulting from the delay in its realization. As a result of these promptings and the initiatives taken recently by several of the member nations, the Commission in 1973 once again retained Mr. Hopmans to prepare a report which would include the countries not members of the Common Market in 1968 and which would be more from the perspective of environmental protection than relieving market distortions. The Commission also convened a committee of experts on waste oils from each of the member nations to advise it during the process of preparing a proposed market-wide regulation of the area. The committee of experts met first in May 1973 and again in November 1973. At its first meeting, the members agreed upon an exhaustive questionnaire to be answered by each of the member nations and agreed to discuss the answers to it at the next meeting as a basis for developing a market-wide policy.

The Commission hopes to develop a regulation for presentation to the Council in early 1974, which, if adopted, would become effective by January 1975. It is interested in such a schedule because, according to a 1973 decision of the Council, a member nation may proceed with its own legislative or administrative environmental initiatives if the Commission has not produced a proposed Community measure on the subject involved within seven months of being notified of the initiative by the member nation and the Council has not acted on the Commission's proposal within five months of receiving it. In September 1973, France notified the Commission of a proposed decree governing the disposal of used oil.

The Commission has prepared a directive for the consideration of the Council the contents of which are described in the preceding section of this Appendix. Several of the member nations are deferring work on developing their used oil disposal programs until the outcome of the proposed directive is clear.

REPORT ON THE
1968 USED OIL STATUTE
OF
THE FEDERAL REPUBLIC OF GERMANY

William A. Irwin
The Environmental Law Institute

for

The Environmental Protection Agency
Contract No. 68-01-2203

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The legislative history of used oil legislation in Germany shows that the country's policy has evolved through the following stages:

1935-1945	mandatory collection in support of a policy of autarchy
1945-1963	tax preferences and protective tariffs in order to conserve foreign exchange, support the small re-refining industry, and preserve a range of prices of certain goods
1964-1968	subsidies to the re-refining industry for the same reason as granting tax preferences to re-refined products (above), and in order to help prevent water pollution
1968-present	industry-financed support of disposal by re-refining and incineration in order to achieve comprehensive environmental protection.

In 1964 the change from tax preference and protective tariffs for re-refined products to a direct subsidy to re-refiners was one of form, not substance. However, revenues spent for a direct subsidy are more apparent than revenues foregone for an indirect one, and by 1966 the attitude of the German Parliament became that the costs for disposing of waste oils safely ought to be borne by those who caused the problem in the first place -- those who produce oil and those who use it.

The motive behind the 1968 Used Oil Statute was chiefly to protect water supplies from the improper disposal of used oils. But the policies of the past -- support of the re-refining industry, interest in encouraging a range of prices for petroleum goods, preference for conserving valuable resources -- and the money it takes to import them -- all these policies are continued by the system created by the new law.

That system is fairly easy to summarize. All who import or produce certain lubricating oils (including re-refiners) in Germany pay 7.50 Deutsche Mark (about $2.25) per 100 kilograms of product to the federal government in addition to the tax on mineral oils. This money goes into a special fund reserved for the support of the disposal of waste oils by incineration or re-refining, the two ways deemed safe from environmental and public health viewpoints in Germany.

Re-refining and incinerating enterprises under contract with the federal Office for Trade and Industry are entitled to apply for payments to cover the costs of disposal not otherwise covered, e.g., by selling the re-refined products. Payments are made at standard rates, 12 DM for each 100 kilograms of waste oil which is re-refined, 10 DM for each 100 kilograms incinerated. It is assumed that re-refining yields

70 percent of the waste oil by weight, so the re-refiners' payments are made on the basis of figures for the weight of a month's re-refined products in the application. Incinerators are paid on the basis of how much of what they burn is oil. The federal office's lab analyzes the contents of special drip devices on a monthly basis and the proportion of the sample which is oil is the basis for figuring the weight of oil burned, for which payments can be made.

The obligations imposed on the disposal firms by their contracts are many. They must: 1) pick up all amounts of waste oils over 200 liters in the district assigned to them; 2) do so at no charge to the user unless the waste oils contain more than 10 percent foreign matter; 3) provide suitable containers for lesser amounts so they can be collected later; 4) keep records of their costs and make their books and other relevant information available to the federal office, or the auditors it appoints; 5) file their applications for payments monthly; 6) maintain equipment specified by the federal office for purposes of checking their output (e.g., the special drip devices mentioned above); 7) give notice of any re-refined products shipped to other member nations of the European Economic Community and repay any payments received for producing these products (this requirement was imposed by the E.E.C. to avoid favoring German re-refiners in violation of the Treaty of Rome); 8) give receipts for waste oils containing more than 10 percent foreign matter.

Those who generate more than 500 liters of waste oils containing more than 10 percent foreign matter (which is not picked up for free) must also keep records on how they dispose of the oil, so that it is possible to trace the chain of disposal from source through collection to final disposition. The collectors, too, must keep similar records.

Since only lubricating oils subject to the mineral oil tax are also subject to the disposal fund compensation assessment, the paperwork, procedures and personnel for levying the assessment are integrated almost completely with the payment of the mineral oil tax. This results in substantial savings of administrative costs.

The following discussion is divided into three parts: I. A supplement to the description of the experience of implementing the 1968 law contained in 1 Ecology Law Quarterly, 480-84; II. An Elaboration of the Meaning of Some of the Provisions of the 1968 Statute; and III. A Legislative History of Used Oil Regulation and Research in Germany from 1935-1968. The provisions of German law (translated into English) and the article about it which appeared in 1 Ecology Law Quarterly 471-494 (1971) ("A Model Waste Oil Disposal Program in the Federal Republic of Germany", by William A. Irwin and Wolfgang E. Burhenne) are reproduced in Vol. 118, No. 42 of the Congressional Record (March 20, 1972) at E 2706-E 2712 and would be helpful to understanding the following discussion.

Part I: Experience Implementing the 1968 Law

I. The Pick-Up of Amounts Less Than 200 Liters

The Used Oil Statute provides that contractors must prepare for the later pick-up of amounts of used oils less than 200 liters, for example by leaving receptacles for persons in their districts who request them. This was provided in the law because the Parliament agreed with the experience of those who had disposed of used oil that it was inefficient to collect lesser amounts than 200 liters. The provision has not altogether answered the question of what should those people who change their own motor oils do with their used oils. Estimates in Germany vary on the number of people who actually do this: a survey conducted by the Esso Company reportedly showed that 15 percent of all drivers changed their own oil, but officials of the Ministry of Economics estimate that only 1 percent of all used motor oils generated in Germany result from these do-it-yourself changes.

Several cities in Germany have taken an initiative which offers one solution to the problem of preventing improper disposal in small quantities of used oil by self-changers. The city of Bonn, for example, has established four places where persons with small amounts of used oil may take it and dispose of it for free. Three of these four are open Monday through Friday from 7 a.m. to 5 p.m., and one operates during these hours on Mondays, Tuesdays, Wednesdays, and Fridays. One of them is open from Saturday morning at 8 a.m. till noon. The city has published and distributed posters informing its citizens as follows:

> To all users of oil and owners of cars: "A better quality of life" and "environmental protection" are requirements under wide discussion nowadays. They are, however, also the responsibility of the entire population.
>
> The harmless disposal of used oil belongs among the most important tasks of environmental protection. The infiltration of used oil into soil or into the sewer system endangers in the extreme our water supplies even though public opinion considers discharges of small amounts insignificant.
>
> Therefore you, too, can and must contribute to this special environmental protection. Give your used oil to the following small collection stations established by the city of Bonn:
>
> (The four locations and the times they are open are then listed.)
>
> Your used oil will be taken without charge to you.
>
> Your contribution to environmental protection to your own safety costs you only a relatively small detour. It will be worth it to you for your good conscience.

One of Bonn's collection centers is near the municipal garbage incinerator. Between May and November 1971 approximately 40,000 liters of used oil was delivered here, both by private persons and commercial enterprises, in amounts of up to 50 liters at one time, the maximum authorized by the city. At two of the other then existing three facilities during the same period 400 and 500 liters respectively were delivered by private persons.

Several other German cities have developed similar programs: Kiel, Braunschweig, Augsburg, Wiesbaden, Muelheim an der Ruhr, Viersen, Witten, Wurzburg, Bremerhaven.

The subject of what to do to control improper disposal by do-it-yourselfers was raised by several representatives in Parliament in written questions to the government. The representatives asked whether it might not be a good idea to amend the Used Oil Statute to provide that changes of oil could only be undertaken in gasoline stations and repair shops. The government responded that such a provision would be very difficult to enforce even with a thorough and expensive administrative effort. It would furthermore lead to the virtual elimination of less expensive lubricating oils from the market. This, the government pointed out, would chiefly affect car owners with less buying power.

The representatives also asked whether better control over improper disposal of used oil might not be achieved by limiting the sale of motor oils to only those firms designed to deal in oil and capable of handling used oils returned to them. In its answer the government pointed out that it had suggested this to representatives of the mineral oil industry in the preliminary discussions of how the Used Oil Statute should be drafted. The oil representatives indicated reluctance to accept a requirement that their dealers accept used oils other than their own. Nevertheless, the government stated, it would pursue again the possibility of persuading each gasoline station and repair shop to accept used oil whether or not in connection with the change of oils. It would also encourage other cities to adopt programs similar to Bonn's. Finally, it would talk to representatives of the department stores and discount stores which sell less expensive lubricating oils with the goal of achieving arrangements whereby these stores would make available to their customers for free the opportunity to have their oil changed at certain places. Such stores in Germany already sell tires under an arrangement that a purchaser of them may have them installed no cost by various service stations. One exemplary department store chain, Kaufhaus Karstadt, already enables its customers to give their used oils to its tire service.

II. Quality of Re-refined Petroleum Products

In Germany there is no requirement that products made from used oils be so labeled. Except for about 5 to 7 percent of their products, re-refiners sell their base stocks to large wholesalers who add

Brand	Name of Oil	Viscosity	API Classification	DM/ Liter
AGIP	WOOM F 1	10W-40	SD	7.00
AMOCO	SUPER PERMALUBE	20W-50	SD	6.90
ARAL	SUPER ELASTIC	10W-50	SE	7.00
	SUPER ELASTIC	20W-50	SE	7.00
	SUPER	10W-30	SE	6.40
	SPEZIAL	20, 30	SC	4.90
BP	SUPER VISCO-STATIC	10W-40	SE	6.60
	SUPER VISCO-STATIC	20W-50	SE	6.60
	ENERGOL HD	20W-20	SE	4.60
	ENERGOL HD	30	SE	4.60
CASTROL	GTX	10W-50	SE	7.50
	GT	20, 30	SE	5.60
ESSO	UNIFLOW	10W-50	SE	6.95
	EXTRA	10W-30	SE	6.55
	EXTRA	20W-20, 30	SD	4.85
* HERTIE	GLOBUS	20W-50	SD	2.50
JET	LTX 2050	10W-50	SE	6.40
	PREMIUM	20W-20, 30	SC	4.70
* KARSTADT	HD-SPEZIAL	20W-50	SE	3.75
	HD-SUPER	20, 30	SE	2.50
* KAUFHALLE	HD-MOTOR-CL	20, 30	SC	2.25
* KAUFHOF	SUPER	20W-50	SD	3.75
MOBIL OIL	SUPER	10W-50	SE	7.40
* NECKERMANN	HD-SUPER	20W-50	SD	3.00
	HD-SUPER	30	SD	2.00
* QUELLE	LANFZWIT MOTOROL	10W-30	SC	4.25
	SPEZIAL MOTOROL	10W-30	SC	3.25
SHELL	SUPER	10W-50	SE	6.95
	X-100	20, 30	SD	4.95
TEXACO	ULTRA	20W-50	SE	6.90
	URSA OIL E.D.	20, 30	SC	4.50
TOTAL	GTS	20W-50	SD	6.90
	SUPER	20, 30	SC	4.85
VEEDOL	SUPER	10W-40	SE	7.20
	SUPER	20W-50	SE	7.20

The brands which are starred are sold by department stores or discount stores. All brands on this table meet the military specification MIL-L-2104 B (equivalent to API Service Classification CC).

additives to them, package them, and market them. They are marketed by brand. These brands are tested by the auto companies, who publish lists of the brands which will meet the requirements of their various engines.

Government officials in Germany are confident that the brands of re-refined oil are of the same quality as those of virgin oil and that a labeling requirement is unnecessary. They believe that such a requirement would be very damaging to the demand for such products, for psychological reasons. They point out that the large oil firms buy considerable quantitites of re-refined base stocks and mix them with their virgin stocks before marketing the resulting lubricating oils.

A recently published comparison of the prices and classifications of lubricating oils by brand is reproduced in the preceding table.

III. Environmental Controls Governing Disposal Firms

Environmental controls over re-refining and incinerating enterprises are imposed by state officials in Germany, either in permits to operate the business or in permits for the business to use waters. There are no national emission or effluent standards which the officials granting these permits must apply. There is also a new (June 1972) federal solid waste disposal law in Germany, administered, as are all such federal statutes, by state officials.

Various state officials have required almost all of the incinerating enterprises to install some kind of device to cool and clean the emissions from the burning of waste oils and other substances. Only two or three incinerating enterprises, however, have demonstrated to the Federal Office for Trade and Industry that they incur additional costs from these devices sufficient to warrant increased payments which are authorized by the guidelines for air pollution control measures. The federal office has no authority to ensure compliance with the conditions imposed by state officials in the operating permits of the disposing enterprises. If a state official complains to the federal office that it cannot achieve compliance, however, the federal office must cease making payments to the enterprise in accordance with section 2(1) of the Used Oil Statute. So far state officials have closed only two disposal facilities, one in Stuttgart and one in the state of Hesse, for failure to comply with their environmental restrictions. Another enterprise, whose poor quality effluents came to the attention of the federal office, was given an extension of time by state officials with jurisdiction over it.

The re-refiners of solid wastes have come under increasingly strict controls for disposal. These wastes can be burned and neutralized and then disposed of in sanitary landfills which are approved. The wastes are then mixed with other wastes there. Some re-refiners have ovens which can burn their acid-clay wastes. Effective implementation of the

June 7, 1972 federal solid waste law in Germany, however, has not been achieved. Several instances of improper disposal of toxic wastes have come to public attention in the past year, culminating a national scandal in the state of Hesse in the summer of 1973. A list of substances discovered at 38 dumps in the state of Hesse last summer, illegally disposed of, included not only oil wastes (e.g., sludges) which should have been collected for a fee under the Used Oil Statute but also wastes from some re-refiners. The public outcry at this scandal has made several state officials much stricter in controlling where re-refiners put their solid wastes, and many re-refiners are having difficulty finding acceptable disposal sites now. The federal office cooperates with state officials in this respect by requiring those enterprises suspected of improperly dumping their waste products to present, along with their application for payments for disposal, proof of where they have deposited their wastes which proofs are then checked with the appropriate state officials.

IV. Results of Implementing the Record Keeping Requirements

The record-keeping books required by section 6 and 7 of the Used Oil Statute should have been kept beginning January 1, 1972. No specific investigation has yet been made by the Ministry for Economic Affairs or the Federal Office for Trade and Industry of the effectiveness of these records in controlling improper disposal of used oils which need not be picked up for free. The Ministry and federal office officials infer from the increasing amounts of used oil disposed of (while sales of lubricants remain about constant) that the record books plus increased environmental awareness are causing more non-re-refinable used oils be burned.

Indeed, there is reason to believe that the capacity for incinerating non-re-refinable used oils is still not sufficient. As of the end of 1972 there were 19 incinerating enterprises, four which also performed re-refining. Their total capacity was 184,000 tons approximately. Usually an incinerating enterprise seeks a mix of used oils and other not so highly flammable wastes to burn, in a mix of approximately 50-50, in order to keep burning temperatures and stack gas temperatures lower. Now that the incinerators have enough used oils there have not been repeated occurrences as there were in the early days of the law's effectiveness, of large oil firms persuading their dealers to deliver their used oils to incinerating firms rather than to re-refining firms.

There is some feeling among German officials responsible for administering the Used Oil Statute that the provisions of section 6 of the law should be amended so that all persons having more than 200 liters of waste oil be subject to the requirements to keep records and submit to government supervision. The provision is of course less necessary to assure proper disposal of good quality waste oils than of difficult to dispose of waste oils, e.g., emulsions and sludges. Not surprisingly, some states in Germany have been more conscientious in exercising their supervisory duties under sections 6 and 7 than other states. Likewise some states say they do more than they actually do. The state of Northrhine Westphalia, which includes one of Germany's most heavily industrialized areas, has been quite energetic in following the chain of disposal in accordance with the second implementing regulation (Appendix 3 of the 1972 report to the German Parliament). Likewise Bavaria's efficient administrative system has performed the supervisory responsibilities of the law effectively. Not surprisingly, rural states, in which waste oil disposal is less pressing, have concerned themselves less with careful supervision in accordance with the Used Oil Statute.

The Ministry of Economics has no present plans to suggest to the Parliament that amendments be made to sections 6 and 7 of the statute concerning supervisory duties. The official chiefly responsible in the ministry feels that both state administrative capacity and the economy affected by the statute itself can be overloaded by being too perfectionist in prescribing supervisory requirements. It points out that the regulations provide that wastes with more than 4 percent oil count toward the maximum of 500 kilograms of oil wastes which may be disposed of without keeping the records required. Practically all firms which use oil at all will arrive at that figure quickly. Experience will indicate whether it is advisable to lower the 500 kilogram figure or otherwise increase supervisory provisions after control over the disposal of the large quantities of the emulsions and sludges works well.

V. Administrative Expenses of the Reserve Fund

The administrative costs of implementing the Used Oil Statute are 1.95 percent of the income to the reserve fund, that is between 650,000 and 700,000 DM annually. Currently 19 persons are employed whose salaries are paid from this fund. Many of them are involved with collecting the specimens of materials burned by the incinerators and checking them in the federal office's laboratory for the percentage of oil in order to determine how much oil was burned which is eligible to receive payments.

Legal challenges to the administration of the Used Oil Statute have been few. There have been some proceedings to determine whether certain goods are subject to the compensation fee or not. Recently the procedure for determining amounts of oil incinerated eligible to receive payments established by the contract between the federal office and the incinerating enterprises was upheld by a court. This was important since the contract fills many of the gaps in administration not made clear by the Used Oil Statute.

VI. Disposal Firms, Districts, Competition and Costs

It is important to observe that used oil disposal enterprises are distributed fairly evenly across Germany. This makes it possible for the federal office, in assigning enterprises mandatory collection districts, to divide the country into regions which include both metropolitan and rural areas. The federal office has arranged it so that everywhere in the country is included in the madatory pick-up districts of at least two enterprises, in order to promote competition among the enterprises. The competition is reflected in the frequency of service which enterprise can give to the persons possessing waste oil and also in the prices it charges for picking up waste substances which are not entitled to free pick-up under the Used Oil Statute. Competition is also reflected in the amounts re-refiners are willing to pay to obtain good quality used oil in some instances.

The collection of used oil itself is divided about equally between that performed by disposal firms themselves and that performed as a service for these firms by collection firms. Many re-refiners, for example, believe that it costs them less to pay for this service than it would to support a fleet of trucks and the personnel to operate them on their own.

It is difficult to compare the costs of collection and disposal among the various enterprises because they are not limited to picking up oil in their assigned mandatory pick-up districts. There are also trade offs in costs: firms assigned large metropolitan areas, for example, find they must pay for good quality used oil, thereby offsetting their lower transportation costs due to shorter distances.

There is vigorous competition among re-refiners to get clean used oil. This results in their willingness to pay for good used oil or to forego charging for the pick-up of used oil which contains more than 10 percent foreign matter, the limit provided in the regulations above which they need not pick up without charging a fee. A practical difficulty with the 10 percent limitation on foreign matter is that there is no simple, probable testing procedure which collectors of used oil can use at the point of collection to determine the percentage of foreign matter.

Part 2: Clarifications and Elaborations of the 1968 Used Oil Statute

I. The Disposal Firms, "Uncovered Costs" for Which They Receive Payments

Section 2(1) of the Used Oil Statute states that firms may receive continual payments for those costs not otherwise covered if they dispose of used oils without harm to water or soil and without causing air pollution. Section 2(2) No. 4 of the statute provides that the payments may not exceed the uncovered costs which arise on the average for the same kind of disposal enterprise.

There are two kinds of disposal methods which may receive payments: re-refining and incinerating. The uncovered costs of re-refining are figured as follows: the actual expenses of the business (including the costs of collection and transportation of the used oil), plus a salary for the owner of the enterprise, plus 6 percent as return on the use of the owner's capital, plus a "reasonable" profit, minus revenues from the sale of the re-refined products. For incinerating enterprises uncovered costs are calculated in the same manner except there is no deduction for sales of products since there are no such products.

There is no fixed percentage which is deemed a "reasonable" profit margin for these enterprises. Discussions in Germany are currently in progress about what constitutes a reasonable profit margin in public works contracts let by the government. Somewhere between 4 and 6 percent of costs seems to be appropriate. The Federal Office for Trade and Industry may or may not follow this guideline when it is finally arrived at.

In order to determine the costs of the enterprises receiving payments the Ministry of Economics has annual audits done by independent firms of the books of the enterprises which perform 60 percent of the re-refining and of the incinerating work. The results of these audits are weighted in order to arrive at average costs for the kind of disposal method. These costs obviously depend on the sizes of the mandatory collection districts assigned to the enterprises. During the audit the firms' collection costs are compared to their operating costs in order to determine whether the size of the districts are appropriate. That is, if a firm has high collection costs because its mandatory district is large but does not show reduced operating expenses as a result of economies of scale from obtaining more used oil to re-refine or burn, then the Federal Office for Trade and Industry will redefine the boundaries of his collection district to make it smaller in order that average costs for that kind of disposal methods not be inflated by unnecessarily high collection costs.

Section 2(2) No. 3 states that the payment rates for individual disposal methods shall take into account and specially compensate costs caused by collection conditions of above average difficulty. This provision was intended to authorize extra payments for collection from islands and for collection by boat of oily bilge waters from inland shipping.

II. The Definition of Used Oils in the 1968 Law

It is important to understand that not everything which might fit within the general concept of "waste oil" is covered by the definition of "used oil" which may be disposed of with the assistance of the Reserve Fund in Germany. Although the terminology of petroleum products is not uniform throughout the world, either in technical literature or in commerce, it is possible to elaborate what the definition includes. This elaboration may help clarify the meaning of "used engine, machine, cooling and similar waste oil" contained in section 104(m)(1) of the FWPCA Amendments of 1972.

Section 3(2) of the Used Oil Statute provides that "used oils within the meaning of subsection 1 (which provides that those having more than 200 liters of used oils may demand their free pick-up) are used mineral oils and used fluid mineral oil products (and) further(,) mineral oil - containing wastes from storage, business and transport receptacles."

A. Legislative History

This definition received considerable attention in the Parliament's deliberations on the various used oil bills under consideration in 1968. The bill submitted by the government was phrased in terms of "wastes" and was designed to establish a record-keeping system to supervise the disposal of "used mineral oils and mineral oil products, further mineral oil containing wastes from storage, business and transportation receptacles." The bill also provided that "other fluid or sludgy inflammable wastes" (e.g., solvents, ether, alcohol, benzene, lacquers, dyes) could be brought within the scope of the laws provisions by regulations "to the extent required for the protection of waterways." In its explanation of the bill, the government stated the definition encompassed the fluid substances named in a 1965 report by the Battelle Institute - oil wastes from motors, transmissions, machines, cylinders, axles, turbines, spindles, transformers, switches and cable insulation; dark oil and white oil; wastes from special gasolines and test gasolines; and from kerosene; oily bilge water; and mineral oil - containing wastes from containers, including oil and gas separators.

The government's bill was introduced in the Bundesrat. In accordance with its procedures, the Bundesrat responded with several suggestions for modifying the bill. Among the suggestions was one that the word "fluid" be inserted before the term "mineral oil products" in order to clarify what was meant (e.g., to make clear that road asphalt was not included). The government accepted this suggestion and added that the word "used" should be repeated before "fluid", so that the revised definition would read "used mineral oils and used, fluid mineral oil products, further mineral oil - containing wastes..."

In the Bundestag a bill had been introduced which defined "used oils and used oil - containing wastes" as all "lubricating oils and fluid as well as sludgy lubricating oil wastes containing a proportion of mineral oil of more than 40 percent by weight." This definition was intended to exclude emulsions, for example (in which the percentage of oil is usually about 10 percent) as well as oil mixtures with large amounts of foreign substances which might be dangerous or difficult to remove. This bill provided for free pick-up of used oils and its drafters were concerned that a broader definition would unduly burden the disposal enterprises. They argued that free pick-up of mixtures containing less than 40 percent oil was not necessary to prevent water pollution, since the water law prohibition against unauthorized discharges imposed a duty to dispose of such mixtures harmlessly and it would still be possible for persons having them to pay the disposal firms to pick them up. They argued further that those having a high proportion of non-oily wastes would derive an unjustified advantage (from free pick-up) over those who did not, even though all paid the same assessment. (This bill provided for a fund supported by assessments from those who acquire or possess lubricating oils and with whom used oils might collect).

Later in 1968 a used oil bill drafted by the Association of German Industries was introduced which sought to define used oils as only those used lubricating oils subject to the mineral oil tax (by no means all lubricating oils) and lubricating substance waste with more than 40 percent lubricating oil by weight. Gas oils used as lubricants would have been excluded by this definition, for example.

On the recommendation of the Health Committee of the Bundestag, to which the used oils bills were referred for purposes of advising the Committee on Industry and Commerical Affairs, the Committee on Industry and Commercial Affairs recommended to the Bundestag that the bill be passed with the definition in the revised form in which it had come from the Bundesrat, i.e., in the form presently in the law.

B. Definition of Mineral Oil

An essay by K. K. Rumpf in the handbook Mineralole und verwandte Produkte (Mineral Oils and Related Products) by Professor Dr. Carl Zerbe explains that the general concept "mineral oil" encompasses primarily petroleum, liquid condensations from natural gas, liquid or salve-like distillates or sediments of petroleum, and natural asphalt, and secondarily, distillates from lignite, bituminous slate, peat or hard coal. This description has been used by German officials to give content to the broad definition of used oils contained in section 3 (2).

The definition in the law was intentionally drafted broadly in order that the law's purpose to protect water, soil and air could be realized as comprehensively as required and as economically as possible.

The obvious but crucial qualification to add to this description is "as far as they have been used." This qualification means that petroleum, i.e. unrefined oil, is not covered by the definition since it is rarely the source of used oils. As a general rule it is products made from petroleum which are intended for use. Thus the oil from cleaning oil tankers is not covered by that part of the definition which reads "mineral oil - containing wastes from storage, business or transport receptacles," since the oil from which these wastes came was not used or intended for use. Nor does the definition cover oil wastes resulting from refining petroleum or cleaning drill rigs, drill holes, pipelines or raw oil transport containers.

Not entirely clear under this definition is when an oil is deemed ready for use. The oils used in the process of producing some lubricants could be seen as a raw material or as an end product ready for use in the production process.

The section 3(2) definition also emphasizes that mineral oil products must be fluid to be used oils. The line between fluid and solid mineral oil products was drawn to make the law practicable. Had this distinction not been made the entire range of solid bituminous substances would have been included, for example. Likewise, greases are excluded by this element of the definition.

In summary, the German law covers minerals oils, mineral oil products and wastes containing mineral oils which 1) have been used and 2) are fluid.

III. The Compensation Fee

A. The Goods It Applies To

Section 4 of the statute provides that the resources of the reserve fund shall be raised by a compensation fee of 7.50 DM per 100 kilograms of certain oils which are also subject to an oil tax. The following are goods for which the compensation fee must be paid:

1) lubricating oils and other heavy oils from section 27.10-C-III of the customs tariff schedule, that is, lubricating oils and other heavy oils
   a) for processing by a supplementary procedure (e.g., vacuum distillation, redistillation, cracking, reforming, refining with selective solvents, polymerization, alkylization, isomerization, desulphurizing, deparafination, treating with concentrated sulphuric acid);
   b) for chemical conversion by other processes than specified above;
   c) for mixing by the importer with other oils or substances to make them thicker: and
   d) for other uses.

Lubricating oils are defined in the customs tariff under heavy oils as oil or other preparations which, when distilled in accordance with ASTM D 86 up to 250 C, do not exceed 65 hundredths including distillation losses or with which the percentage of distillation at 250 C cannot be determined by this method. 2) Gas oils for the functions described in 1)a), b) and d) above, to the extent used as lubricating oils. Gas oils are defined as those which when distilled in accordance with ASTM D 86 up to 350 C exceed at least 85 hundredths including distillation losses. 3) Greases with their heavy oil components.

B. Legal Characteristics of the Compensation Fee

German officials emphasize that the money paid by producers of lubricating oils which goes to the Used Oil Reserve Fund is neither a tax nor a user charge nor an assessment. In German law, user charges and assessments are only levied on those who benefit from the public facility or service (e.g., sewage treatment plant, waste removal) to which they must contribute. The producer of oil has no economic benefit from the resources of the Reserve Fund since payments are made to those who dispose of used oil, not to him.

The amounts paid by the oil producers are designated as a compensation fee to support a system of economic regulation. The characteristics of the fee are: that it is not intended for the revenues needed for covering the State's financial requirements, but rather for definite purpose of economic management; that the receipts are not administered by finance officials but rather are collected in a special fund; that the collected receipts are all spent in the granting of assistance and are thus, except for the administrative expenses incurred, promptly disbursed. This last mentioned characteristic is the so-called equalization principle, i.e., the correlation between imposing a burden and granting a benefit. This principle is the crucial distinguishing factor separating these fees from taxes.

Thus, the fee is a form of self-help compelled from the industry for the benefit of the industry. The state levies the fee not for itself but only as an intermediary. It makes payments within the same circumscribed industrial sector as is subject to the fee (in this case the oil industry, in which the refineries are those burdened and the used oil disposers are those benefitted).

Such fees are based on the Article of the German constitution which authorizes laws which intervene in economic life to order and manage it. They are an instrument of state control of the economy designed to equalize the market situation to the burden of a temporarily advantaged sector and to the benefit of a temporaily disadvantaged sector which functions by imposing fees on the one side and granting assistance to the other side. They are most common in the agriculture and food sectors of the economy. For example, the German grain law provides for a fee which may be levied in order to generate funds to equalize freight costs (and thus grain prices) for producers distant from shipping centers.

C. How the Level of the Compensation Fee Was Determined

The Ministry of Economics suggested to the Parliament that it be allowed to set the level of the compensation fee by regulation. This suggestion was not acceptable, however, so Ministerialrat F. Kruse proceeded to prepare a chart predicting the resources needed for the Reserve Fund and the level of compensation fee required to generate these resources.

Based on his experience in administering the subsidy paid for re-refining used oils, Kruse projected for three years the amount of consumption of lubricants, the amount of used oil which would be eligible for payments for disposal under the bill (including a 15 percent tolerance for foreign substances and excluding the wastes from tanks and separators and the amounts of used oil re-used prior to disposal). He predicted approximately 40 percent of the lubricants consumed would become used oils and of this amount he forecast that 65 percent would be suitable for re-refining. These percentages were based on extrapolations from data accumulated during the 1960's.

Next Kruse calculated the costs of disposal, including collection and transportation. He estimated 9DM per 100 kilograms for the incineration and 12DM per 100 kilograms for re-refining. He included the costs for land disposal and burning it oneself in the predicted costs for incineration since there was no way to predict how much used oil would be disposed in these ways. Costs of administration were also included. Total costs were predicted to be 39,000,000 DM in 1969, the first year of operation, 40 million in 1970 and 41 million in 1971.

To figure the basis for the proposed compensation fee it was simply necessary to take the figure for total import and production of the lubricating oils proposed to subject to the fee and deduct from that amount lubricating fats (5 percent) and the oils used as raw materials (for which the fees paid would be reimbursed) (15 percent).

It then was simply necessary to multiply this remainder by a DM amount per 100 kilograms which would result in the DM amount for total projected expenses. An original suggestion of 5DM was seen to be too little as a result of the later decision not to subject oil used as raw materials to the fee. 5.50DM multiplied by the estimated remainder produced figures that were only about a million DM short per year. This shortage might not actually occur, Kruse suggested, since the costs for disposal would be reduced by 1.7 million annually if payments were made for disposal of used oil with only 10 percent foreign matter, as was planned, rather than the 15 percent contained in the prediction. And since figures weren't available on how much greases were produced or imported, no amounts were figured as subject to the fees; in fact the actual amounts might produce as much as another 1 million DM.

Contravening these possibilities which supported a suggested fee level of 5.50 DM per 100 kilograms lubricating oils were two unknowns. One, it was not clear as of the time Kruse prepared his prediction (September 6, 1968) whether it would be possible to collect the fees for the products in inventory on January 1, 1969, the first day of the proposed bill's projected effectiveness. The other unknown was whether the re-use of used oils by those who generate them for lower lubricating functions would decline below the projected levels, as it had tended to do in the late 1960's. If so, then there would be more used oils to dispose of than predicted without corresponding resources in the Fund.

In the course of deliberations, it was decided that it would be administratively much easier and less expensive if only those lubricating oils already subject to the tax on mineral oil products would be subject to the used oil compensation fee. The result of this decision was that the amount of oil subject to the fee was reduced, necessitating an increase in the amount of fee per 100 kilograms. This change, coupled with the one suggested by the Ministry of Health -- namely, that not only used oils from lubricating oils be disposed of with the aid of the Reserve Fund, but all wastes containing mineral oils (e.g., including heating oil sludges) -- which increased the amount of oils to be disposed of, resulted in elevating the compensation fee rate to 7.50DM per 100 kilograms. It was later decided that this could also be applied to inventory existing on January 1, 1969, a decision which assured the result that the Reserve Fund would have a sufficient extra amount in it at the beginning of its life to enable it to operate for several years without the need to request the Parliament to increase the rate of the compensation fee.

IV. The Interpretation of Business for Purposes of Record Keeping

Section 6 provides that commercial and other economic enterprises must keep a record book for each business in which at least 500 kilograms of waste oils not entitled to free pick-up accumulate for a year. Business is interpreted not to mean the legal entity, for example, a corporation or a partnership, but rather a business unit in the sense of having its own equipment and personnel. For example, a drilling unit of a company with its own equipment and operating personnel would be a business for purposes of Section 6(1). That unit would have to keep records of used oil generated if more than 500 kilograms were not entitled to free pick-up.

V. Officials Responsible Under State Law for Helping Administer the 1968 Law

Section 6 and section 7 of the statute provide respectively that an "official responsible under a state law " may either approve centralized maintenance of records or exempt one from duty to keep records and that the official responsible under state law must be furnished with certain information. These officials named are quite uniform: for enterprises under the jurisdiction of a mining official, that mining official is the official responsible under state law for purposes of the Used Oil Statute; for other businesses the official responsible under state law is the local official authorized to grant permits for the use of state waters. Occasionally these latter enterprises have building officials or county supervisors as their named responsible state officials.

These same officials responsible under state law are charged with administering fines which result from the violations of regulations which are enumerated in section 10 of the statute.

VI. Regulations Under the 1968 Law Applicable to Inland Shipping

Section 8(2) of the Used Oil Statute authorizes the Federal Minister for Traffic to issue regulations in agreement with the Federal Minister for Health Affairs with provisions for inland waterway transportation concerning the collection of waste oil from water craft, barges, etc. There are three sets of such regulations, one for the Rhine, one for the Mosel, and one for other inland waterways, issued on August 5, 1970, June 8, 1971, and March 3, 1971, respectively. These regulations are part of amendments to general regulations implementing federal laws governing inland waterways. With respect to used oil disposal they provide that authorized collection places are those listed in an appendix as duty-bound to collect as well as those authorized to collect by state officials with jurisdiction over the waterways. The regulations also provide that it is a violation of section 10(1) No. 5 of the Used Oil Statute to intentionally or negligently keep an oil record book improperly, fail to keep the oil record book on board, or fail to deliver oil wastes or liquid inflammables including waste waters containing oil.

Part 3: Legislative History of Used Oil Provisions

I. 1935-1945

In 1935 a law was passed obligating all re-refineries to file reports. In conjunction with this, a duty was imposed that all used motor oils be delivered to the re-refiners. The re-refiners picked up from all gas stations and repair shops, though not from self-changers, or users of small amounts or from industry (which either burned its used oils or otherwise disposed of them). This system, which was instituted as part of a policy of autarchy, also had a beneficial effect in limiting water pollution - approximately 40 percent of the used lubricating oils generated at that time were collected and re-refined. (The Germans imposed the same system in Poland, Norway and the areas which are now part of the German Democratic Republic. Reportedly it still exists in these countries).

II. Post World War II until 1963

After World War II, the support of collecting and re-refining used oils was continued. Lubricating oils made from used oils received a mineral tax preference of 13 DM per 100 kilograms. In addition re-refined lubricating oils were protected by provisions of the customs law: imported petroleum was subject to a duty of 12.50 DM per 100 kilograms, while the duties on imported virgin lubricating oils ranged from 12.90-22.50 DM per 100 kilograms. The duty on imported re-refined products was 25.90 DM per 100 kilograms. This latter provision was justified as necessary "to keep domestic re-refining of used oils profitable." With the support of these provisions the re-refiners - which were all small - were able to increase their collection of used oils from 37,000 to 123,000 tons between 1953 and 1963. That represented an increase of from 20 percent to 34 percent of the used motor oils.

Germany was obligated to dismantle these tax advantages and customs protections in accordance with an agreement to alter the provision governing the taxation of oil which all the signatory nations of the European Economic Community accepted.

III. December 1963 Law Enacting Subsidies for Re-refining

This was accomplished as part of a law passed by the Parliament in December 1963 reforming several provisions concerning taxes and customs. However, on the initiative of the Finance Committee of the Bundestag, this compensatory provision was added as an amendment to the bill prepared by the executive branch; "Enterprises located in the Federal Republic which paid taxes for lubricating oils in accordance with section 2(1) No. 1 of the Mineral Oil Tax Law in 1962, may receive, upon application, a temporary subsidy for lubricating oils (re-refined products) which they produce from used oils generated and collected in the Federal Republic and ship from their firm...The temporary subsidy for lubricating oils which were defined as the heavy oils enumerated in the customs tariff which are shipped from the firms in the years 1964 and 1965 is 22.90 DM per 100 kilograms." The new section provided that no subsidy be paid for lubricating oils not subject to the Mineral Oil Tax as a result of other sections of the revised Mineral Oil Tax Law and authorized the Minister of Finance to adopt regulations governing the procedures for implementing the new section.

In explaining the new section the Finance Committee stated that it had thoroughly discussed the business and political economy issues raised by the bill for the small enterprises currently re-refining used oils. "The existence of these firms would be threatened if their products, which are more expensive to produce, are subject to the same tax as fresh oils. If these enterprises close, a possibility is lost for the disposal of used oils which is important to our political economy."

The Finance Commmittee also called on the executive branch to "investigate the situation and cost structure of the field of collecting and re-refining used oil and to suggest to the Parliament by June 30, 1965 new provisions which promote the collection, re-refining or disposal of such oils in the interst of protecting waterways, ground water and soil."

A. Amendment of the 1963 Law in REsponse to E.E.C. Objections, April 1964

This subsidy provision provoked objections from the Commission of the European Economic Community and from the other member nations. They argued that the payment of such a subsidy for re-refined products exported from Germany was a kind of export subsidy which contravened the Treaty of Rome that is the basis for the E.E.C. The Parliament reacted promptly, in March 1964, by considering a bill which would have prohibited the export of re-refined products to member nations of the E.E.C. The Finance Committee decided, however, that rather than such a prohibition it would be consonant with the Treaty of Rome and consistent with the Committee's goals in adopting the subsidy if payments made for re-refined products which were exported to the E.E.C. nations were repaid by the re-refiner. Such a bill became law in April 1964.

The regulations adopted to implement the December 1963 subsidy provisions, as amended, are included as an appendix A, pages 57-63.

B. The First Report to the Parliament by the Ministry of Economics, June 1965

The report called for by June 1965 was submitted punctually. Since the Parliament had already extended the subsidy provisions for another year, however, the report provided considerable information about the country's waste oil situation (although not about the cost structure of collection and re-refining) but postponed any specific recommendations to the Parliament. The apparent reason for the extension and postponement was the expectation that the Commission of the European Economic Community would propose waste oil regulations for all the Common Market Nations.

The 1965 report was based on one prepared by the Battelle Institute in Frankfurt under contract with the Ministry of Economics. It stated that of the 750,000 tons of lubricants sold in 1963, 55 percent was consumed so the consistency and distribution of any wastes offered were no practical threat of water or soil pollution. Of the remaining 345,000 tons, 30 percent was re-used for other lubricating purposes without generating significant wastes, 30 percent was burned and 33-35 percent was collected and re-refined.

Thus, only 8-10 percent of the lubricants not fully consumed in their first use presented - to the extent not properly disposed of on land - constituted a continual threat to water and soil. Nevertheless, this amounted to approximately 35,000 tons a year. How much of this actually ended up in the nation's waterways could not be definitely determined, the report stated. But some indications were given by the results of an investigation conducted by the state of Northrhine-Westphalia of the pollution of the Rhine in that state. Within the boundaries of that state alone 10,000 tons of oil ended up in the Rhine. Almost all of it flowed in with the tributaries. In addition shipping on the Rhine itself contributed approximately 8,000 tons annually of waste oils, comprised of up to 70 percent fuels. This latter figure would be 3,000 tons higher but for the work of a state-supported public corporation which collected oils from the ships and took them to re-refiners. "These figures show," the report stated, "to what extent the Rhine has become a kind of collection sewer for the waste oils from many individual disposal sites and to what extent the surface waters which are being increasingly used for water supply are endangered."

The Battelle report had concluded that an altogether satisfactory disposal of all waste oils not heretofore collected would be practically no problem in a few years. The Ministry of Economics considered this a reasonable view, given that the re-refiners were expanding their collecting capacity with the support of the federal subsidies, that oil users were delivering more waste oils or disposing of them themselves and that the states' water pollution control officials were having more success in preventing danger from waste oils. The Ministry nevertheless concluded that the 35,000 tons of waste oil improperly disposed of should be brought under control as quickly and completely as possible "to prevent a danger to soil and water." It also suggested a long-range goal that the federal budget should not be burdened with the costs of harmless disposal of used oil. Rather users of oil should pay them. In order to avoid sudden changes in the business conditions of the re-refiners, this conversion should occur gradually, beginning with a reduction in the subsidy affective January 1, 1967, the report concluded.

(The following is a summary of some of the technical information contained in the Battelle Institute's report to the Ministry).

In Germany, according to the Battelle Institute's 1965 report, somewhat more than one-half of the wastes generated by the use of lubricants and mineral oil solvents or cleaning agents collects at gas stations and repair shops. The rest is distributed among countless sources. In consistency - the most important factor in their disposal - 80-90 percent of these oil wastes (including foreign matter) were liquid, 5-15 percent were in the form of sludge, and 5-10 percent were more or less solid. The amount of foreign matter (also important to disposal possibilities and consisting of water, metal rubbings, dust, sand, etc.) in each of these categories varied greatly. The report foresaw only a slight increase in the amount of liquid waste oils in the coming years, but more liquid/sludge wastes from cleaning oil and gas separators and tanks.

There were, the report's summary concluded, no technical limits preventing harmless disposal of oil wastes: there are several means of disposal for each waste product. But in some cases disposal entailed high costs. Thus the most economic solution can only be determined for individual situations.

The section of the report dealing with kinds of wastes and possibilties for their disposal pointed out that only general values can be given for the characteristics (percentage of oil, water, foreign matter, additives) of each general form of waste and that in practice the wastes are mixed in countless ways in the process of collection. Therefore the choice of which of six possible disposal methods to use most depend on the circumstances of the particular case. As possible disposal methods the report listed:

1. Re-use for the same or inferior purposes
   a. without prior treatment (i.e., filtering or centrifuging), or
   b. after prior treatment;
2. regenerating (i.e., distilling, refining);
3. burning
   a. without prior treatment
   b. after prior treatment, or
   c. mixed with mineral oil-containing or other wastes or products or with the help of supporting fire;
4. depositing in places where danger to water and soil is not present and where it can be done in accord with legal provisions:
5. chemical binding;
6. biological degradation in relatively short time.

The first three of these - reuse, regeneration and burning - without expensive pretreatment were described as technically the least problematic and economically the most promising methods. 80-90 percent of all mineral oil containing wastes could be taken care of in these ways. Pretreatment before burning was also technically possible, although it did increase costs and result in small amounts of a new waste - sludge.

Depositing was seldom seen as practical due to lack of suitable land. Chemical binding involves transforming the oily wastes into products harmless to water by means of the so-called irreversible oil binders introduced in the mid-1960's for use in controlling oil spills. This means of disposal was seen as economic under special conditions: the treated wastes could be deposited in specially prepared ditches. The possibility of employing biological degradation was described as not yet sufficiently clear from a scientific viewpoint. In principle, mixtures containing small amounts of oil are rapidly degraded where the living conditions for micro-organisms are favorable, i.e., plenty of movement of water and oxygen.

The forms of oil wastes most difficult to dispose of are sludges and unseparated emulsions from metal-working. For the former the method used chiefly is burning in special ovens, although this method has problems with charging the ovens and detoxifying the emissions. Large garbage incinerators can also accommodate oily sludges. Unseparated emulsions normally have too much water content to make burning possible without an expensive supporting fire. Separation followed by burning the oil portion is more economic.

C. The Second Report to Parliament by the Ministry of Economics, 1966

Further investigation by the government revealed more information, some of which modified the thrust of the 1965 report. This information was brought out in answers to several questions put by representatives in the Bundestag in August 1966 and in a supplementary report to the Parliament dated October 27, 1966.

"Is the government aware," began the representatives' series of questions, "that the collection of waste oils for regeneration or disposal has not kept pace with the increased amount of oils used thus increasing the danger to soil and water?" Yes, the government answered, it was aware. Lubricants sold had increased from 1963 to 1965 by 106,000 tons to a total of 844,000 tons while in the same period the collection of waste oils increased by 34,000 tons to 157,000 tons. To the extent waste oils are not properly disposed of they are a continuous danger to water and land.

"How much are the annual amounts of waste oils disposed of in uncontrolled ways," was the second question. The answer: by statistical extension of the 1963 figure of 35,000 tons, in 1946, 46,000 tons and in 1965, 51,000 tons were disposed of by unknown means.

Three days after these answers were published a bill sponsored by Rep. Dr. Schmidt and 31 fellow members of the Bundestag was introduced to extend the subsidy for two more years (until December 31, 1968) and reduce it from 22.90 DM per 100 kilograms to 19.50 DM per 100 kilograms. In their justification of the bill the sponsors stated that only by means of the subsidy to private firms was the collection and regeneration of used oils - "a task of the highest significance to our health and political economic policies" - made possible. Since the E.E.C.'s effort to harmonize member nations' provisions had not yet been successful, it was necessary to extend the temporary provisions in order not to interupt the firms' work, the sponsors stated. The reduction in the amount of the subsidy was, based on a check of the industry's economic development, acceptable as well as desirable for budgetary reasons.

Since this bill also reflected the views of the government, the Federal Minister of Economics stated at the conclusion of his October 1966 report that detailed recommendations from the government would be superfluous. The report did provide, however, the results of the investigation into the cost structure of collecting and regenerating used oil. By way of introduction, the report reiterated the amount of used oil collected (pointing out that 38% of the motor oils sold were collected, equivalent to the percentage collected by the system established in 1935). There was also a cautionary note in the introduction. An increase in the amount of used oils used for heating was problematic for several reasons. Insurance companies would not provide protection for enterprises heating with used oil because of the increased risks of fire and explosion. Further, the Federal Minister of Labor and Social Affairs and the local building and commerce officials (who are responsible for granting permits for many new enterprises to operate) raised objections to the use of used oils for heating instead of heating oils, on similar grounds, especially if proper burning facilities were not employed.

The investigation of costs for 1964 and 1965 was complicated by the fact that the tax preference was not replaced by the subsidy until May 1, 1964, and frequently the re-refineries did not keep records in a way that distinguished between these two aspects of 1964. Nevertheless, it was evident that without the 22.90 subsidy there would have been losses amounting to 17.75 DM per 100 kilograms for the re-refineries in the period in 1964 after the subsidy became effective.

The weighted average prices for re-refined products declined steadily during 1964-65. In 1962 the price was 60.94 DM per 100 kilograms; in 1963, 59.43 DM; and in 1964, between May and December, 58.64 DM. A comparison of the 1963 and 1964 prices shows a possible effect of the subsidy: a sinking of the average price of .79 DM per 100 kilograms, or 1.3%. This development in prices contrasted with the contrary tendencies of the fresh oil market. While the oil firms lowered the prices of goods which were in direct competition with re-refined products, the prices of lubricating oils in the firms' own gas stations were raised significantly.

Average net receipts for re-refined products rose 1.86 DM per 100 kilograms between May 1 and December 31, 1964. Coupled with costs reduced by .03 DM the average profit from producing re-refined products was 1.89 DM per 100 kilograms. This development meant that if the subsidy were reduced by 1.90 DM to 21 DM per 100 kilograms the domestic market would be in the same situation as when tax preferences were granted (until April 30, 1964) without on the average weakening the re-refiners' capacity to compete with the large oil firms. Such a reduced subsidy would still compensate on the average for the losses which the re-refiners would experience without it: in the best situation normal expenses would result in losses of 11.60 DM per 100 kilograms; in the worst, all expenses would result in a loss of 21.25 DM per 100 kilograms. The average loss would be 17.75 DM per 100 kilograms.

The government's October 1965 report also observed that collectors of used oils, e.g., gas stations, were receiving approximately 2.20 DM per 100 kilograms in payment for their waste oils. This subsidy of collection, the report said, was not tolerable for the federal budget in the long run and offered the possibility of a further reduction of the subsidy by 1.10 DM per 100 kilograms. Too rapid a removal of the "collection premium," however, would mean that used oils would no longer be separated by kinds for collection or kept free of avoidable wastes and water and that more users would dispose of their oils in uncontrolled ways leading to enhanced water pollution. The report recommended more efforts to increase public understanding of the dangers of oil pollution for land and water as a means of promoting care in sorting and storing of oils and eventually of giving up oil without expecting to be paid for it.

The report pointed out that the answers provided by the governments of several Laender to questions from their representatives indicated that not only was the disposal of used oils not systematically supervised but also that burning them in proper facilities was not even to a starting point. On the positive side, some re-refiners had committed themselves to picking up used oils whenever possible. The report recommended publicizing these pick-up points.

IV. The Two-Year Extension of Subsidies for Re-refining

A. Controversy over the Bill

Dr. Schmidt's bill to extend the subsidy to re-refiners for two years and reduce its amount from 22.90 to 19.50 DM per 100 kilograms was referred to the Finance Committee, (of which Schmidt was chairman) with the Budget Committee in an advisory role. These two committees disagreed, however. the Finance Committee reported the bill favorably as drafted. The Budget Committee, on the other hand, pointed out that the proposed 1967 budget contained no provision to cover the 26 million DM in expenditures which the bill would occasion. Further, the committee thought the amount was too much to be justified by keeping in business 20 middling firms with a total of 1,000 employees. As for the argument that the bill would contribute to water pollution control, that field was under the jurisdiction of the Laender and it was improper to burden the federal budget with expenditures for that purpose. The Budget Committee recommended to the Finance Committee that the bill be rejected and reported thus to the full Bundestag.

These contradictory reports caused the Bundestag to refer the bill back to the two committees for further deliberations.

The Finance Committee informed the Budget Committee that it was in sympathy with the tendency to eliminate subsidies, but that here an exception was in order. The subsidy only became necessary because the change in the tax preference for re-refined products and the customs duty on fresh oils had been required. It was also important for reasons of water pollution control. The Budget Committee was requested to support the bill in spite of some difficulties with where in the budget the expenditures would be covered.

The Budget Committee responded that the bill violated the principle that each person who caused water pollution was responsible to undertake control at his own expense. The Budget Committee wanted a phasing out of the subsidy, to be replaced by increasing the price of fresh oil to cover the costs of waste oil collection and disposal. It voted to recommend to the Finance Committee that the subsidy be reduced from 22.90 DM per 100 kilograms to 17 DM per 100 kilograms for 1967 and 14 DM per 100 kilograms in 1968 (instead of to 19.50 for both years as the bill provided). For this amount the budget could cover the bill's expenses.

Reluctantly, but in order not to lose the whole bill, the Finance Committee decided to follow the Budget Committee's recommendation and to urge expeditious study of the problems involved, including the E.E.C.'s harmonizing efforts, so that a permanent approach could be adopted as soon as possible.

The debate on the bill in the Bundestag, which runs nine printed pages, was not without rancor. It was essentially a debate between the two committees. Finance argued that Budget's suggestion would save a mere three million DM. Budget said that many re-refiners operated efficiently enough that they didn't need more subsidy than would cover the average losses of 17.75 DM per 100 kilograms. Finance replied that some needed more, some needed less and the end result would be the same if one wished to make subsidy payments based on the individual situations of each of twenty-odd re-refiners. It appeared that the government's proposed budget had not contained an entry to cover the extension of the subsidy its report supported because the Budget Division of the Ministry of Finance disagreed with the government position and had left the entry out intentionally. (The Division had likewise approached the Budget Committee in opposition to the Finance Committee's bill). Throughout the debate it was clear that all parties agreed that a permanent solution was urgently needed. One of the reasons it had proposed a reduction to 14 DM per 100 kilograms in 1968, Budget said, was to add an element of financial pressure toward achieving a solution. To this Finance answered that there was a strong risk several re-refiners would close, thereby reducing the amount of waste oil collected and increasing the danger to public health.

The upshot was that the bill passed the Bundestag in the form suggested by the Budget Committee. The upper house, however, the Bundesrat, shared the views of the Finance Committee and requested a conference committee. The conference committee recommended the subsidy be extended for two years but reduced to 19.50 DM per 100 kilograms re-refined product, i.e., the original bill. The conference committee's recommendation was approved in both the Bundestag and the Bundesrat. The bill was signed into law in May 1967, effective retroactively to January 1, 1967.

B. The Third Report to the Parliament by the Ministry of Economics, April 1968

One of the August 1966 questions to the government posed by Representative Dr. Schmidt and his colleagues requested it to update the February 1965 Battelle Institute report on the causes, sources and whereabouts of mineral oil-containing wastes "with the goal of reviewing and more closely determining for what reasons, in what kinds of uses, and how much used oils are not collected or properly disposed of." This question also requested the government to present the Parliament with suggestions for improving the situation when the results of the renewed investigation were available.

The Ministry of Economics, in concert with the Ministry of Health, presented this third report on April 5, 1968. The government's covering memorandum to the Parliament highlighted three conclusions to be drawn from the second round of research:

1) the frequently-suggested supposition that as a result of technical developments and sinking demand for lubricants the amounts of used oils would steadily decline was false: from 1963 to 1966 the amounts of used oils generated had increased by 35,000 tons to a total of approximately 370,000 tons and by 1970, 400,000 tons was anticipated;

2) by 1966, 50,000 tons less used oil were burned or re-used by industry than in 1963, perhaps because of stricter application of air pollution provisions. On the other hand, re-refining of collected used oils increased by 60,000 tons;

3) the amounts of used oils disposed of in uncontrolled ways

increased by 6,000 tons to 39,000 tons. The question "why do these amounts exist and from what kinds of uses do they come" couldn't be answered, the report stated, despite specific questioning in more than 150 interviews, although for the most part they seemed attributable to oil emulsions (discharged into sewers) whose proper disposal was freighted with heavy costs, especially for small and medium sized businesses. The reasons for dumping waste oils on land or discharging them into water ways were a) avoidance of the costs of collection and proper disposal, b) negligence and c) inadequate knowledge of proper procedures..

Fifty percent of the 369,000 tons of used oils in 1966 were generated by traffic (45 % from automobiles, 1% from trains and 4% from inland shipping). Thirty-five percent came from industrial, commercial and craft industry sources, another 12 percent from the agricultural sector. Wastes from cleaning oil tanks and/or gas separators amounted to 2 percent and 1 percent respectively. While. for 1963, Battelle estimated that 30 percent of the used oils were re-used, 35 percent re-refined and 30 percnet incinerated or burned for heat., these percentages for 1966 were 20 percent, 49 percent and 20 percent respectively. The dumping or discharging of the 39,000 tons constituted approximately 11 percent of the disposal, up 1 percent from 1963.

As mentioned, most of this 39,000 tons (4.6 percent of all lubricants consumed) was in the form of water-soluble oil emulsions discharged to sewers by small and medium sized metal working plants without proper facilities. Improper disposal by do-it-yourself automobile oil changers, at construction sites and from inland ships could not be determined. Oily sludges and solid wastes normally found their way to public garbage dumps along with other industrial wastes. It was clear, according to the 1968 Battelle report, that primarily those oil wastes whose proper disposal is expensive or difficult or both are dumped on land or in water. Only large firms could afford to separate the oil from their used emulsions, for example, or centrifuge the oil from metal shavings.

The report included the results of a questionnaire requested by the Ministry. Gas stations and automotive repair shops were asked whether, if they had to pay to have used oils collected from them, they could charge drivers .10 DM per liter of drained oil at the time of changing their oil. Industrial and commercial plants were asked if they would dispose of used oil themselves or continue to give it to collectors if it would cost .10 DM to dispose of each liter of oily wastes. The gas stations and repair shops replied that to directly pass the costs fo used oil disposal on to drivers was out of the question. They feared the loss of customers. Approximately 5 percent stated that if such a regulation were adopted they would absorb the costs themselves. Even those who said they would continue to deliver their used oils for disposal assumed that a system which charged the user of oil for its pick up would lead to an increase in uncontrolled disposal of used oils. The breakdown of industrial and commercial response to what they would do if it cost .10 DM per liter to dispose of oil wastes:

-continue to deliver-	45%
-burn in an incinerator-	25%
-heat with it-	10%
-burn it in open-	10%
-re-use it until consumed-	5%
-dispose of it self, by undefined means-	5%

The 1968 report concluded with a few predictions of trends in waste oil generation and disposal. Consumption of lubricants had increased from 700,000 tons in 1963 to 845,000 in 1966. This rate of increase was not expected to continue, however, because of improvements in the quality of oil (longer intervals between changes), improved sealing (reducing leaks) and machine construction, and closer supervision of the use of lubricants by businesses. By 1970, Battelle estimated, 900,000 tons of lubricants would be sold. Taking the same percentage as 1966 of oil totally consumed in used (58%), approximately 380,000 tons of used oils would be generated in 1970, excluding the wastes from cleaning tanks and separators. Battelle foresaw an increase of these latter wastes since its questionnaire indicated that 25% of all industrial and commercial plants had never cleaned their tanks or separators. Municipalities, furthermore, were making efforts to provide for more cleaning and for the disposal of the resulting wastes.

Developments in disposal would depend on the factors influencing each of the disposal methods. As of the time of the 1968 report, 82% of the businesses polled said they had no problem disposing of their oily wastes. Whether this figure could continue depended on developments. Reuse of oils, for example, was hindered by the fact that tax-favored transformer oils could not be used where other higher-taxed oil would normally be. On the other hand re-use would increase as the difference between the price of new oils and the costs of collecting and pretreating used oils increased. Re-refining had increased 46% between 1963 and 1966 (during a period when oil sales had increased 14%), but predictions about whether this trend would continue were not possible due to the uncertainty of whether the subsidy payments would be continued. Incineration or burning of used oils for heat was still too expensive (60-180 DM per ton) for most firms to consider this disposal method. More garbage incinerators were being constructed although even present capacity to burn oil wastes was not being utilized. The number of firms burning used oils for heat had declined since 1963, even though they had to pay no heating oil tax. Disposal of emulsions remained a problem, particularly for the small firms which couldn't afford devices to separate the oil from the water.

V. Three Bills Prepared in 1968 Concerning Used Oil Disposal

In anticipation of the December 1968 expiration of the subsidy payment provisions, representatives of the federal ministries of economics and health began to collaborate with a special committee of the Landerarbeitsgmeinschaft Wasser, an "interstate" working group for water matters, late in 1967. Concurrently Representative Dr. Schmidt and his colleagues in the Interparlamentarische Arbeitsgemeinschaft, a kind of legislative council made up of representatives from all parties elected to state and federal parliaments, were working on a bill. The government sent its draft bill to the Bundesrat in June 1968 for its advisory comments prior to introducing it in the Bundestag. Dr. Schmidt's bill was introduced directly into the Bundestag in the same month and referred to the Committee for Economics and Commercial Affairs. The government's bill was forwarded to the Bundestag in September along with the Bundesrat's comments and the response of the government to the comments. In October, a bill prepared by the Association of German Industries was introduced by several representatives. The government's bill and the Association's bill were referred to the same committee in late October.

A. The Government's Bill

The government's bill provided that all industrial and commercial enterprises where 500 kilograms or more of used mineral oils or mineral oil products or wastes would be generated annually and enterprises collecting such wastes would keep record books indicating kind, amount and whereabouts of such wastes. It also provided that enterprises collecting oily wastes from others would be licensed. A license was to be denied if the applicant could not demonstrate that he or someone to whom he would transfer the wastes could re-use, regenerate or dispose of them in a way that would cause no concern for water pollution. It was also to be denied if the applicant's proposed facilities or means of collection posed a threat of water pollution or if facts supported the assumption that the applicant or the manager or the personnel of the business was not sufficiently reliable. Conditions designed to protect waterways could be attached to a license and, once granted, the license could be revoked if these conditions were broken or if any of the reasons for denying the application subsequently appeared. The bill also provided that any person holding a license or keeping a record book was required to provide to authorized officials all information needed to implement the law, especially concerning the supervision of the ultimate disposal of the wastes. The officials responsible for implementing the law would be named by the Lander. A special provision was included in the bill exempting shipping from the foregoing and authorizing regulations to be promulgated governing collection of oily wastes from ships at certain intervals and places. The bill concluded with provisions declaring penalties for revealing trade secrets learned in implementing the bill and for violating any of the duties set forth in it.

The explanation accompanying the government's bill promptly conceded that the bill contained no provision for financial support of harmless disposal by regeneration, incineration or otherwise, since there were no resources in the federal budget after 1968. Without these subsidies the government could not say how the problem of proper disposal was to be solved economically. The explanation stated that the purpose of the bill was to protect the waterways from pollution, since even a small amount of oil could make a surface or underground water supply unusable. The existing legal regime - the municipalities' sewer ordinances proscribing the disposal of oil; the commercial code authorizing conditions in the operating permits of businesses to prevent discharges of used oils; the water law's provisions authorizing officials to take action to halt discharges which are or may be polluting - offered recourse only against individual cases of pollution by businesses which generate them, not any possibility to prevent collection techniques which threaten water pollution. The bill was designed to remedy these deficiencies.

The Bundesrat's first comment to the government on its draft bill was that it should investigate whether and to what extent its bill should be changed in light of Representative Dr. Schmidt's bill or perhaps simply combined with it. "The commercial regulation foreseen in the draft bill should be supplemented by a financial regulation which provides payments for the harmless disposal of mineral-oil-containing wastes and these provisions should take effect, if possible, at the same time." The Bundesrat suggested that businesses with small branches be allowed to apply for permission to keep the record books centrally so long as the necessary supervision of disposal was not hindered. The Bundesrat also suggested that it was not necessary to require enterprises collecting oil wastes from others to be licensed. Collectors had been in business without being licensed since 1935 and no difficulties were known which would justify the requirement of a personal license. The licensing requirement would involve an administrative burden and was contrary to the government's announced policy, enacted into law in the commercial code, that as few businesses as possible be regulated by licensing. The combination of record-keeping and the government's power to obtain information from those keeping records should be sufficient means to the bill's end of assuring that waste oils be properly disposed of so as not to pose a threat of water pollution. Instead, suggested the Bundesrat, one should simply be required to give notice that he collects and the government be authorized to order him to take measures to prevent water pollution or to prohibit him from collecting if he proves unreliable.

The government's response to the Bundesrat readily accepted the suggestion that it investigate aligning its bill with Dr. Schmidt's but disagreed with the suggestion that licensing collectors was unnecessary, particularly in light of the forthcoming expiration of the subsidy payments to re-refiners. A final decision would be made after the suggested investigation, the government concluded.

B. Rep. Dr. Schmidt's Bill

Representative Dr. Schmidt's bill was essentially what is now contained in the first four sections of the Law Concerning Measures to Assure the Disposal of Used Oils, a title taken from his bill. It provided for the creation of a reserve fund for the purpose of enabling payments to compensate the uncovered costs of firms disposing of used oils by harmless means. The fund was to be supported by an assessment on producers of 5 DM per 100 kilograms of lubricating oils. Pick-up of oil in amounts more than 200 liters was to be free. The bill provided that if used oils could be re-refined, that means of disposal should be preferred.

Since this bill - along with the committee's report - show the most about what the Parliament had in mind in establishing this new system, it is important to relate its legislative history in some detail.

The explanation accompanying Representative Dr. Schmidt's bill stated in its introduction that the subsidies in force until the end of December 1968 had been enacted for the threefold purpose of protecting waterways, encouraging a supply of lower-priced oil and supporting the re-refining industry. Since without these subsidies the re-refining firms couldn't exist, a new law was required so that the approximately 180,000 tons of used oils collected from nearly 280,000 sources would not be disposed of uncontrolled.

"The premise (of the bill) is that the lubricating oil producing and using sector should solve the problem of waste oil disposal itself. Because of the strongly divergent interests of the parties an approach based on voluntary cooperation would not assure the required protection of the general public. Therefore a public arrangement should be created to intercede between those having used oils and the firms which dispose of them. The costs of used oils disposal should be borne by those who cause them by paying an assessment. This assessment constitutes no additional financial burden; rather it only reflects the costs which in any event occur from the use of lubricating oil. The assessments would support a capable network of firms who would have to pick up used oils subject to the assessment."

The bill's first section is identical to section 1(1)-(2) of the present law. The purpose was to create a special fund solely for the purposes of the law. Administration of the fund was assigned to an existing federal agency to avoid the costs of creating a new administrative organization. The costs of administration were specifically to be drawn from the fund in order not to burden the general budget.

Section 2 provided that payments could be made to commercial enterprises for costs they could not cover in disposing of used oils without damage to water, soil or air. In which cases firms disposed those oils assessed would be collected for free under section 3 of the bill, assessing only lubricating oils meant that heating oil, wastes or bilge oils would not be included. The rate of 5 DM per 100 kilograms was estimated "based on experience to date."

According to section 5 the assessment was to become due when oil was shipped from the firm or cleared customs after import. Levying the assessment on those who had used oil not only would cost more administratively but would give them reason to dispose of used oils improperly in order to avoid the assessment. The bill's sponsors pointed out that from the standpoint of the fund it made no difference who paid the assessment but that "in accordance with experience it would follow the laws of the market and be passed on to the last user. The extent to which producers and importers were called on to make payments was based on a benefit to them from the fund which existed even if not mentioned explicitly, namely that the fund solves the problem of waste oil disposal which is in fact caused by putting a dangerous good on the market. In addition reasonable considerations of the public interest indicate that any additional burden is neither inappropriate or intolerable."

C. Rep. Stein's Bill (Association of German Industries)

The bill introduced in October 1968 by Representative Stein and colleagues on behalf of the Association of German Industries paralleled Dr. Schmidt's bill in many respects and also incorporated sections of the government's bill. This bill offered three principal differences from the others: 1) it suggested that waste oil be defined as only the lubricating oils from section 27.10-C-III of the customs tariff which have been used; 2) it suggested that payment rates be equal according to kind of used oil disposed of rather than kind of disposal method used; and 3) it suggested levying the assessment for used oils on gas stations and other enterprises required (by the bill) to keep records of the amounts of used oil generated if more than 500 kilograms annually, rather than on the producers or importers of fresh oil.

D. The Committee's Report on the 1968 Used Oil Statute

The report of Representative Opitz on behalf of the Committee for Economics and Commercial Affairs refers to the reservations with which Parliament enacted the existing subsidy provisions and reports that the Budget Committee did not even respond to an inquiry whether the subsidy could be extended for a short time in order to avoid incurring the additional administrative expenses of converting to a new system which was likely to be replaced soon by one adopted by the European Economic Community.

The report indicated that the government had conferred with Representative Dr. Schmidt and his colleagues and that all agreed, as did the Committee, that merely requiring possessors of used oils to keep records of their disposal would not be sufficient. "What must be achieved is to assure that the disposal of used oils is accomplished without additional water and air pollution. If one possessor were burdened alone and directly with the cost of disposal a greater part of the used oils collected until now would be disposed of uncontrolled. Therefore the Committee has followed...(Representative Dr. Schmidt's) bill to the extent that at the point of bringing fresh oil on the market there should be an assessment for the harmless disposal of used oil," The report stated it had decided in favor of assessment at this level rather than the level suggested by the Association for reasons of administrative ease and efficiency, of having a procedure which would assure maximum protection of water quality, and of having a system which would not be difficult to coordinate with the forthcoming European Economic Community regulation.

The report enumerated other decisions the Committee made on the alternatives before it. Since the principal goal of the act was to assure disposal of used oil in order to protect water, chiefly ground water, the Committee could not agree with Dr. Schmidt and his colleagues that re-refining used oil should be treated preferentially. "On the contrary, the Committee believes that over the long run a strong price competition must develop between the individual methods of disposal in order that the payments and the assessment may be kept low." The Committee decided to limit the assessment to the lubricating oils subject to mineral oil tax, in order that the administration of the assessment could be based on the already existing tax procedures. But the definition of the waste oils to be collected for free was not limited to the oils subject to the assessment. Instead, a provision was added that used oils with more than a certain amount of wastes would not have to be picked up for free.

As general observations the Committee noted that the payments should encourage the trend to disposal facilities with larger capacities in order to make continued observation of the air pollution from the disposal firms possible. It also stated that means for disposal of other wastes should not be prejudged in the light of the used oil statute. This law provides special measures to deal with the special dangers posed for water by used oil.

In its discussion of the individual provisions of the bill it reported, the Committee explained some of the other changes it made in the bills it considered. In section 2 the Committee added language authorizing public corporations and other non-commercial enterprises as a means of enabling facilities set up by municipal cooperatives, for example, to qualify if they disposed of oil properly. Although it dropped the language in Dr. Schmidt's bill specifically providing it, the Committee indicated in its discussion of section 2 that payments would be made to those who held contracts with the federal office for trade and industry obligating them to fulfill conditions derived from the Minister of Economics' guidelines in order to receive payments.

of oil without damage would be determined by regulations promulgated by the Minister of Economics. The bill's section 2 also provided that payments would be made in accordance with guidelines which were to fulfill certain legislative requirements. Most of the enumerated requirements were eventually incorporated in section 2(2), with the exception of the one providing that "re-refinable used oils shall be re-refined to the extent economically and technically reasonable." The present law's section 2(3) is verbatim what was in the bill's section 2(3).

The bill's explanation pointed out that the provisions of section 2 extended financial support of waste oil disposal to other methods than re-refining. The regulations were designed to establish "binding standards" for what constituted harmless disposal. Of special significance was the explanation of the payments: "The payments should not compensate the individual costs, not covered by profits, of collecting and harmlessly disposing of used oil, but rather the costs determined to be average for a kind of disposal method. If individual losses were compensated there would be no incentive for a firm using a certain disposal method to improve his efficiency. Furthermore, the administration of the fund would be over burdened if it could not work with generally applicable payment rates instead of concerning itself with the situations of individual firms. Thus, firms working at unfavorable above-average costs will not receive payments which assure their existence." Likewise only uncovered costs specifically from collecting and disposing of used oils were to be compensated, not costs from other branches of a firm. The bill's sponsors recognized that the payments would compensate to varying degrees the costs arising from varying collection and disposal circumstances, but suggested this could be equalized by considering carefully the distances assigned for mandatory free pick-up.

Section 3 of the Schmidt bill provided that pick-up of more than 200 liters would be free and preparation for pick-up of lesser amounts was required. But it defined the waste oils to be picked-up as all lubricating oils and fluid or sludgy wastes with more than 40 percent by weight of oil. (See the discussion of this suggested definition under the section entitled "Definition of Used Oils"). It also provided that only used oils subject to the assessment would be picked up for free. The pick-up of other substances would be in accordance with fee schedules filed with the federal agency administering the fund.

Section 4 was the funding provision for the fund created by section 1. It provided that those who produced or possessed lubricating oils or substances containing them and with whom waste oils could collect would pay a charge of 5 DM per 100 kilograms of the lubricating oils enumerated in section 27.10 C-III of the customs tariff schedule. This suggestion was based on the analogous and familiar concept in German water law that those benefitted by a public service should pay the assessments which support it. Since only

Not included in a contractor's obligations, however, would be pumping out tanks, separators or ship bilges.

In its discussion of section 3 the Committee explained why it had followed the government's characterization of the means for funding the reserve fund rather than the suggestions contained in the bills proposed by Representative Dr. Schmidt or Representative Stein. Assessments implied a benefit to those assessed, it pointed out, and there is not a complete identity between those liable and those gaining the benefits from pick-up. (For a more complete description of the nature of the funding system, see the discussion of the Legal Characteristics of the Compensation Fee). The government's characterization makes it clear that what is involved is a self-help mechanism operating within the oil producing and using sector of the economy.

The bills introduced by the representatives had included provisions authorizing payments to industrial firms which disposed of used oil harmlessly itself. The Committee decided not to follow this suggestion because: 1) the Committee on Health had argued persuasively that it was important to concentrate used oil disposal in large facilities, for health reasons; 2) the over-all effectiveness of the system would not be able to be evaluated; and 3) the compensation fee would have to be raised significantly.

The Committee limited the record-keeping called for by section 6 to those persons having more than 500 kilograms of used oils which would not have to be picked up for free in the belief that free pick up would remove any reason for people to dispose of their oils improperly. This would also limit the burden of keeping and checking records to about 20 percent of all used oils generated, e.g., emulsions.

The Committee on Industry and Commercial Affairs received two of the three bills concerning used oil disposal on October 23, 1968. It gave them priority review "in recognition of the special urgency of establishing a system for used oils, above all for reasons of public health" and filed its report on November 29, 1968. The bill, as reported by the Committee was passed by the Bundestag and forwarded to the Bundesrat on December 6, 1968. The Bundesrat passed the bill in the same form and it became law December 23, 1968.

REGULATIONS CONCERNING THE GRANTING OF TEMPORARY SUBSIDIES FOR THE PRODUCTION OF LUBRICATING OILS FROM USED OILS

(RE-REFINED PRODUCTS)

On the basis of Article 8, section 6 of the Law Concerning the Amendment of Taxes on Mineral Oil of December 20, 1963, amended by the Law to Amend the Law Concerning the Amendment of Taxes on Mineral Oil of April 16, 1964, the following regulations are promulgated.

Section 1: Certification of Right to Subsidy

(1) The temporary subsidy in accordance with Article 8 of the Law Concerning the Amendment of Taxes on Mineral Oil may only be approved when the right to the subsidy has been certified.

(2) Certification is to be applied for in duplicate within two months of the effective date of this regulation.

(3) The central customs office responsible for the location of the enterprise is responsible for the certification.

(4) The application shall include 1) name and purpose of the enterprise, 2) owner of the enterprise, 3) name of the person responsible for the management of the enterprise, 4) weight of the lubricating oil taxed in 1962 in accordance with Section 2(1) No. 1(g) of the Mineral Oil Tax Law, 5) weight of re-refined products produced in 1962 and sold in 1962 and 6) capacity of the enterprise for producing re-refined products.

(5) The information required in paragraph (4) 4)-6) shall be substantiated at the request of the central customs office.

(6) If the deadline named in subsection (2) is missed without fault an extension may be granted.

(7) The certification is to be given in writing. Thereupon the one entitled to receive the subsidy shall acknowledge that 1) he must keep the records described in Section 3, 2) he must label re-refined products in accordance with Section 5, and 3) he must repay subsidies improperly paid out.

Section 2: Revocation of the Recognition

The certification shall be revoked if the conditions for its granting did not exist or later expired.

Section 3: Record Books

(1) The one entitled to subsidies must keep records of 1) the

amounts of used oil processed, separated according to used oils generated and collected in the Federal Republic and other used oils, 2) the weight of the lubricating oils produced from used oils generated and collected in the Federal Republic, 3) the weight of lubricating oils produced from other used oils, 4) kind and weight of the substances added to the lubricating oils designated under 2) by the producing firm and 5) the day of shipment from the producing firm of the lubricating oils designated in 2).

(2) If the information required in subsection (1) is apparent entirely or in part from records already kept on the basis of other legal provisions then the records required by subsection (1) are to that extent not required.

Section 4: Granting of the Temporary Subsidy

(1) The temporary subsidy will be granted upon application for the amount of lubricating oils shipped from the producing firm in a month. The application is to be submitted in duplicate by the fifteenth of the month following to the central customs office specified by Section 1, subsection 3. The application shall certify that the lubricating oils shipped from the producing firm were produced in that firm from used oils generated and collected in the Federal Republic.

(2) The central customs office determines the amount of the temporary subsidy on the basis of the extent to which it is justified and the proof required in Section 3 is furnished.

(3) The central customs office sets off the temporary subsidy against the mineral oil tax to be paid by the applicant by the twenty-fifth of the second month following the shipment. In the case of Section 6(1), sentence 2 of the Mineral Oil Tax Law of 1964 the subsidy is to be set off against the mineral oil tax due by the fifteenth of the second month following the shipment and, to the extent that it exceeds the tax liability, with the mineral oil tax due on the fifth of the third month following the shipment.

(4) If the mineral oil tax liability is not sufficient in accordance with subsection (3) the amount of subsidy in excess of the tax liability is to be paid.

(5) If the deadline named in subsection (1) is missed without fault an extension may be granted.

Section 5: Duty to Label

Th labeling required by Article 8, section 4, sentence 1 of the Law Concerning the Amendment of Taxes on Mineral Oil must be by printing on the bill or delivery slip. The printing must read as follows: "For this product a subsidy was paid in accordance with Article 8 of the Law

Concerning Amendment of the Taxes on Mineral Oil of December 21, 1963, amended by the Law to Amend the Law Concerning Amendment of Taxes on Mineral Oil of April 16, 1964. Upon export to member nations of the European Economic Community the amount of 22.90 DM per 100 kilograms is to be repaid to the federal government in accordance with Article 8, section 3 of the law."

Section 6: Investigations

(1) The central customs office specified by Section 1(3) may undertake investigations of the enterprise in order to determine whether the conditions for receiving a subsidy exist or have existed. For these investigations the one entitled to the subsidy is required to present documents relevant to the temporary subsidy; he is further obligated upon request to provide information. The federal auditing office is entitled to the same rights of investigation.

(2) If re-refined products are exported to the member nations of the European Economic Community the customs administration may undertake investigation of the exporter to determine whether temporary subsidies were paid for the exported re-refined products. For this investigation the exporter must present documents related to the re-refined products and must provide information upon request. The federal auditing office is entitled to the same rights of investigation.

(3) For public entities and personal corporations the individuals accorded representative status bylaw, contract or bylaws are to fulfill the duties of subsections 1 or 2.

(4) A person obligated to provide information may refuse to provise information to those questions whose answers would subject he himself or one of the employees listed in section 383(1) No. 103 of the Civil Procedure Law to the risk of criminal prosecution or a proceeding in accordance with the Law Concerning Violations of Regulations.

Section 7: Validity in Berlin

This regulation is also effective in the state of Berlin in accordance with Section 14 of the Third Transition Law of January 4, 1952 in conjunction with Article 14 of the Law Concerning Amendment of Taxes on Mineral Oil.

Section 8: Effective Date

This ordinance is effective on the day after its publication.

Bonn, the 23rd of April 1964

FIRST ANNOUNCEMENT TO SUPPLEMENT THE REGULATIONS CONCERNING THE GRANTING OF TEMPRORARY SUBSIDIES FOR THE PRODUCTION OF LUBRICATING OILS FROM USED OILS (RE-REFINED PRODUCTS) OF APRIL 23, 1964

I offer the following comments on the implementation of the above-named regulations:

(1) Article 8 of the Law Concerning Amendment of the Taxes on Mineral Oil of December 20, 1963 was amended by the Law to Amend the Law Concerning the Amendment of Taxes on Mineral Oil of April 16, 1964. In accordance with these amendments no temporary subsidies are paid for exports of re-refined products to member nations of the European Economic Community and temporary subsidies paid are to be repaid in these cases. The recipient of temporary subsidies - that is the producer - is subject to the notification requirement of section 5 of the Regulations.

(2) "Taxed" within the meaning of Article 8, subsection 1, sentence 1 of the Law Concerning the Amendment of Taxes on Mineral Oils includes those lubricating oils which were subject only to a conditional tax liability in the year 1962. That is, an enterprise which for example in 1962 only shipped re-refined products from its firm upon order is likewise entitled to receive subsidy payments.

(3) Used oils which originated from German and foreign ships in German harbors as well as from ships from free ports and from the occupying forces count as generated within the Federal Republic.

(4) Use of re-refined products by a producer himself or the use of re-refined products to produce other products in that same firm is not entitled to subsidies. The temporary subsidy is expressly linked with shipment from the producing firm. As is for example evident from Section 3 of the Mineral Oil Tax Law of 1964 this factual situation shipment does not include use within a firm.

(5) Untaxed re-refined products or those shipped from the producing firm upon order are likewise eligible for subsidy.

(6) Lubricating oils in accordance with Article 8, section 1, sentence 2 of the Law Concerning the Amendment of Taxes on Mineral Oils are only eligible for subsidy if they are re-refined products, as is evident from Article 8, section 1, sentence 1 of the law. A product is still as a whole a re-refined product if in addition to re-refined substances per se other substances (for example additives) up to a maximum of 5 percent by weight are included. If a product has more than 5 percent by weight of other substances it is as a whole no longer a re-refined product and is therefore as a whole not entitled to subsidy payments. Mixing of other substances outside the producing firm does not influence the eligibility for subsidy since only the condition and amount of the product at the moment of shipment from the producing firm are controlling.

(7) Because of the small number of enterprises eligible for payment and the provisional limitation to two years of the temporary subsidy I am providing for a central printing of the forms for applying for certification of subsidy rights and for grants, as well as for the record books.

(8) The central customs office shall request an investigation of applications for payments by the auditing official responsible for the firm of the applicant.

(9) The official of the auditing service certifies the result of his investigation on the application and returns it to the central customs office.

(10) The central customs office determines the amount of the temporary subsidy and requests the financial officer to pay the applicant by way of his customs account. If the tax notices of the person entitled to subsidy are submitted to a customs office the central customs office shall send the payment request to the cashier's office of the customs office which establishes the set-off.

(11) The temporary subsidy is to be booked under Chapter 6002, Title 994. The budget funds are deemed to have been appropriated.

(12) Legal disputes are subject to the provisions of the Administrative Court Regulations of January 21, 1960. The form giving information about legal procedures is printed in the Federal Customs Gazette of 1960 at page 658.

(13) For the execution of repayments the provisions of the Administrative Execution Law of April 27, 1953 apply.

(14) I request to be informed concerning issues of controversy of large significance. By November 1 of each year the central customs offices inform the upper financial administration, and by December 1 of each year the upper financial administration informs me about issues of controversy, special expenses, difficulties, and the experience with investigations. I request that the number of firms entitled to receive subsidy also be given. In the report filed on December 1, 1964, the amount of payments paid between May 1 and September 30, 1964 are to be indicated and in the report for December 1, 1965 the amount of payments between October 1, 1964 to September 30, 1965 are to be given.

APPENDIX C

THE EFFECTS OF WASTE OIL ON FRESHWATER AQUATIC LIFE

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ABSTRACT

This study was undertaken to assess the toxicity of waste oil to freshwater aquatic organisms. A summary of the preliminary data obtained during the initial six months of the study is presented in this report.

The major organic component of the waste oil was found to be saturated hydrocarbons (76 percent) while major inorganic components were lead (1.9 percent) and zinc (0.1 percent). Equilibrating a 10 percent mixture of oil (v/v) with water produced a solution of water soluble components containing 80 percent polar organic compounds, 4.4 mg/l lead and 16 mg/l zinc.

Acute mortality studies showed that the levels lethal to freshwater fish ranged from 0.1 to 1.1 percent by volume total oil depending on the species tested and the method of introducing the oil.

A chronic exposure of the water soluble fraction of waste oil to the freshwater fish, Jordanella floridae, was conducted. The "no effect" level, based on egg production and fry survival, was estimated to be between 0.08 and 0.33 percent of the water soluble fraction solution. Tissue residue analysis indicated that significant accumulation of normal hydrocarbons, lead, zinc, and cadmium occurred.

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SECTION I

CONCLUSIONS

The waste oil studied contained about 76 percent saturated hydrocarbons, ranging from 20 to 30 carbon atoms/molecule, 4 percent aromatic hydrocarbons comprised primarily of alkyl benzenes and polynuclear compounds, and 4 percent polar compounds. Metals present included lead (18,500 µg/gm); and zinc (1,350 µg/gm).

The fresh water soluble fraction of work oil tested was markedly different from the oil in that it contained 80 percent polar compounds, only 3 percent saturated compounds, and 14 percent aromatic compounds. The metals found included zinc (16,000 µg/l), lead (4,400 µg/l) and cadmium (60 µg/l).

The waste oil was essentially free of chlorinated compounds.

Short-term laboratory mortality tests indicated that the approximate lethal level to freshwater fish was 0.1 to 1.1 percent by volume total oil depending on species tested and the method of introducing the oil.

A chronic "no effect" level, based on egg production and fry survival, for the freshwater fish, Jordanella floridae was between 0.08 and 0.33 percent by volume of a water soluble fraction stock solution. This corresponds to between 80 and 330 µl/l total oil as defined by experimental conditions.

Tissue residue analyses indicate that significant accumulation of normal hydrocarbons, zinc, lead, and cadmium occurs. No evidence of accumulation of aromatic hydrocarbons above the µg/gm level was found.

SECTION II

RECOMMENDATIONS

Toxicity information from the tests conducted in this study suggest that a recommended safe level be between 80 and 330 μl/l total oils. However, the chemical characterization of the waste oil indicates the potential for damage due to lead exists at concentrations less than 8 μl/l total oil.

Studies on organisms other than fish, on fish flavor impairment, and in field test conditions are necessary to determine if levels below the "no effect" level for fish are hazardous.

The possibility of creating chlorinated hydrocarbons during the effluent chlorination process and their effects on aquatic life should be determined.

Studies should be conducted to determine present contamination levels for waste oil in the freshwater ecosystem.

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SECTION III

INTRODUCTION

In recent years concern has been expressed over the realization that each year as much as 500 million gallons of used crankcase oil may be introduced directly into the environment with another 250 million gallons disposed of in an unknown fashion (Bernard, 1971; Ostrander and Kleinert, 1973). Therefore, in the 1972 Amendments to the Federal Water Pollution Control Act, the U. S. Congress requested EPA to study the waste oil disposal problem. Since virtually no information existed for the biological effects of waste oil, research in this realm was part of their request. Waste oil has been defined for this study as used crankcase oil.

Although little information existed on the disposal of waste oil, some of the known uses which result in the introduction of oil into the environment include: road oil use (estimated at 150-200 million gallons), land disposal (estimated at 300 million gallons), and dumping in sewers (estimated at 12 million gallons). It had been reported that as much as 70% of the road oil used is lost due to runoff (Freestone, 1972). This runoff was in the form of oil and oil-wet soil particles. The oil might be as a surface slick, emulsified, or only the water soluble fraction. The purpose of this study was, therefore, to investigate the effects of waste oil as it might be introduced into the environment. This was accomplished by determining acute and chronic waste oil toxicity levels for fish, tissue accumulation levels and the characteristics of the oil in its various forms to identify potentital toxic components. The following report is an interim report based on preliminary analysis of data available at report preparation. A final report will be prepared upon completion of experimentation.

SECTION IV

MATERIALS AND METHODS

Toxicant Preparation and Characterization

Two separate samples of used crankcase oil were obtained from Arrowhead Refinery Company of Duluth, Minnesota. The oil was collected from several gas stations, mixed and stored in 55-gallon drums. When oil was required for specific tests, equal amounts were taken from each sample and mixed.

Oil was introduced into the various biological tests either as an emulsion, as a layer, or as the water soluble fraction. The oil-water emulsions were prepared by blending oil and water at the required ratios in a Waring Blender[1] for two minutes. For layering, oil was gently poured on top of the dilution water in the test containers. Solutions of the water soluble fractions were prepared by pumping Lake Superior water through oil at a 9:1 ratio for 18 hours. This mixture was allowed to separate for 6 hours after which the aqueous phase was removed and used as the soluble fraction stock solution. A new stock solution was prepared weekly for chronic tests and every 4 days for acute tests.

The oil and the water soluble fractions were characterized both for comparison to other waste oil studies and to determine the possible toxic components in the oil. Components characterized include physical, metallic, and organic compounds.

The organic fraction of the waste oil was characterized in a preliminary manner by separating the compounds into volatiles, saturated hydrocarbons, aromatic hydrocarbons, polar compounds, and solids. The volatile compounds were isolated by stripping the oil with N_2 and trapping the vapors on a column of XAD-2 nonionic resin (15 ml). The non-volatile components were further separated through chromatography on silicic acid in which the oil (1 gm) was transferred to a 120 x 7 mm silicic acid column and eluted sequentially with 12 mls of hexane, benzene, and methanol to give the saturated, aromatic, and polar fractions, respectively. The materials not eluted from the column were presumed to be solids (particulates).

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[1] Mention of trade names or commercial products does not constitute endorsement or recommentation for use.

The saturated and aromatic chemicals were characterized in more detail by GC/MS analysis. The saturated and aromatic mixtures were separated on a 6' x 2 mm column containing 3 percent OV-101 and programmed from 50°C to 250°C at 4°C/minute. The classes of chemicals present were assigned on a basis of the mass spectra obtained and/or GLC retention data.

Additional analyses on the oil were performed by the U. S. Bureau of Mines Bartlesville Energy Research Center. Included were general descriptive characteristics of lubricating oils and thirteen metals.

The organic components of the water soluble fraction stock solution were characterized by passing the water through XAD-2 resin columns and subsequently eluting the adsorbed material with methanol or ether. The data indicated that approximately 80 percent of the saturated and fluorescent compounds were removed from the water. The extracts from the XAD columns were impregnated on activated silicic acid and eluted with hexane, benzene and methanol to determine major compositional changes between the waste oil and the water soluble fraction. The resulting fractions were examined in more detail by GC/MS analyses discussed in the appropriate section of this report.

Metal concentrations in the water soluble fraction toxicant were measured by atomic absorption. Standard flame techniques (Perkin-Elmer, 1973) were employed for the analysis of cadmium, nickel, iron, manganese, copper, lead, zinc and chromium. Flameless atomization methods (National Water Quality Laboratory unpublished data) utilizing an HGA-2000 Graphite Furnace (Perkin-Elmer), were also employed for the analysis of cadmium, lead, molybdenum, cobalt, arsenic and selenium.

The "dissolved" metal ion component of the soluble fraction was determined by analyzing filtrate from membrane filtration (Millipore) using various pore size filters. Experiments were also done to make certain that contamination and absorptive effects from the filter were not a problem.

Tissue residues for the various oil components were analyzed in fish exposed to the water soluble fraction. Both organic and metallic residues were investigated using the following techniques.

Because of the small size of the fish after 45 days of exposure, the organic tissue residue analyses were performed on composite samples from toxicity tests, blended with Na_2SO_4, and extracted with three 50 ml portions of 25 percent CH_2Cl_2 in hexane. The combined extracts were concentrated to 5 ml, centrifuged to remove particulates, and evaporated to dryness in tared pans to determine the lipid content of the fish.

The "hydrocarbon residue" in the fish was operationally defined as the residue which is stable to fuming H_2SO_4. This residue was obtained by transferring the extract to a column containing 15 gm Celite 545 impregnated with 9 ml of fuming H_2SO_4 (10 percent SO_3). The residue was eluted with 200 ml hexane, evaporated to dryness, and weighed with a six-decimal balance. The residue was transferred to a centrifuge tube and diluted to 3 ml for GLC analysis of electron capturing materials and hydrocarbons.

To assure that the acid-Celite technique did not alter the results of the hydrocarbon analysis, several samples were prepared for GLC analysis with Florisil. A column of 20 gm dry Florisil was prepared and the sample was eluted with 250 ml of hexane.

Fish tissue digestions for metal residue analyses employed a nitric acid-perchloric acid digestion procedure (Leonard, 1971). Zinc, cadmium and lead concentrations were measured by atomic absorption as previously indicated.

Biological and Physical Test Conditions

Lake Superior water was used as the dilution water in all tests. Temperatures in flow-through tests were maintained by mixing heated and ambient Lake Superior water, whereas temperatures were maintained in static tests by placing all tanks in a water bath. All flow-through tests were conducted with the water soluble fraction of the waste oil using a modified 2-liter proportional diluter (Mount and Brungs, 1967; Benoit and Puglisi, 1974).

In the acute tests duplicate concentrations of 5, 2.5, 1.25, 0.62, and 0.31 and 0.00% by volume of the water soluble fraction stock solution were used. Since the stock solution was derived from 10% oil in water, these concentrations correspond to a range from 0.50 to 0.00% in terms of total oil. For comparison between tests, LC50's will be given, when applicable, both in terms of percent total oil and percent of the water soluble fraction. The glass test containers were 36x22x26 cm deep and held 14 liters. Test containers were randomly arranged and received approximately 10 tank water volumes of toxicant solution per day. A combination of Gro-lux and Duro-test fluorescent bulbs were used to provide a constant 16-hour daylight photoperiod at 40±5 foot candles measured at the water surface.

In the water soluble fraction chronic test, duplicate nominal concentrations of 1.0, 0.40, 0.16, 0.064, 0.026 and 0.0% by volume of water soluble fraction stock solution were tested. The glass and silicon glue adult and fry test containers were 30x60x30 cm deep holding 42.5 liters, and 30x38x30 cm deep holding 10.6 liters respectively. A constant 16-hour daylight photoperiod of 100±15 foot candles measured at the water surface and a flow rate of 6 tank water volumes per day were used.

In the static acute mortality tests 30x38x30 cm deep tanks holding 12 liters were used with emulsified oil and the water soluble fraction tests. For layered oil tests containers 30x24x24 cm deep holding 18 liters with a baffle at one corner were used. The baffle was needed for aeration of the tank without disturbing the floating oil. Fish were added after the addition of oil to test containers in the tests with the water soluble fraction and with emulsified oil and before the oil was added in the tests with layered oil. Concentrations tested were 10.0, 5.0, 2.5, 1.25, 0.62, and 0.0% by volume stock solution for the water soluble fractions; 4.0, 2.0, 1.0, 0.5, 0.25 and 0.0% by volume of total oil for the layered oil and 2.5, 1.23, 0.62, 0.31 and 0.0% by volume total oil for the emulsified oil.

Static and flow-through acute mortality tests were run with the flagfish, *Jordanella floridae* and the fathead minnow, *Pimephales promelas*. In all exposures organisms were held at test temperatures for at least two weeks previous to testing. Static mortality tests with flagfish were conducted with the water soluble fraction and emulsified oil using ten four- to six-week old juveniles per test container. Temperatures were maintained at 24±1° C. A static test with *Pimephales promelas* was also performed with layered oil using fifteen two-month old fish per tank at 20° C.

Two flow-through acute tests with the water soluble fraction of oil were conducted using fifteen four- to six-week old flagfish juveniles per test container at 25° C and ten two-month old fathead minnows per container at 20° C.

Mortalities for dissolved and layered oil acute tests were measured at 0, 1, 3, 6, 12, and 24 hours and daily thereafter. Mortality was determined by the lack of movement upon gentle prodding and dead fish then removed. Since fish in the emulsified oil test could not be seen due to the oil, all fish were removed after 96 hours and mortality determined.

The chronic *Jordanella* toxicity test was conducted utilizing the Recommended Bioassay Procedure for *Jordanella floridae* (Goode and Beane) Chronic Tests (National Water Quality Laboratory Report, 1972). This test can be summarized as follows:

a. Fifty eggs were distributed in each tank for hatching.
b. Twenty of the surviving fry were raised until 30 days old when they were thinned to 15 fish per tank.
c. At 5 weeks two spawning substrates were placed at the end of each tank. When a male became territorial over each substrate, the extra males and all but five females were removed.

d. Eggs deposited on substrates were counted and tested for hatchability.

e. The mortality and growth of one-day old fry were determined in the same and different toxicant levels at which they were hatched.

f. Chemical residues were measured in tissues of fish thinned at various times during the test.

g. Survival, growth, eggs produced per female, and egg hatchability were the parameters used to determine effects.

Since lead and zinc organometallic compounds are added to lubricating oils, the concentrations of these metals, as determined by flameless atomic absorption spectroscopy, were used to monitor the test systems. Samples for the chronic exposure were taken twice weekly from each tank. Samples for acute exposures were taken several times per test.

Temperatures on all tests were checked daily while dissolved oxygen was measured in each test container with a YSI Model 51 Oxygen Meter three times per week. Hardness, alkalinity, pH and acidity were measured in 4 tanks each week for the chronic tests and twice during acute tests according to Standard Methods for the Analysis of Water and Wastewater (1971).

SECTION V

RESULTS AND DISCUSSION

Toxicant Characterization

I. Characterization of Waste Oil

The waste oil was fractionated into volatile, saturated, aromatic, polar, and particulate compounds. This section presents a summary of the characterization of the selected test oil.

A. Composition of Major Fractions of the Test Oil (Table 1)

The selected waste oil was shown to contain approximately three percent volatile chemicals by weight. The volatile compounds trapped from the N_2 were separated by GLC as indicated by the chromatogram in Figure 1. GC/MS analysis of the volatile fraction indicated that the major volatile components were alkyl benzenes and naphthalenes. Table 1 summarizes the major volatile compounds found.

Table 2. MAJOR VOLATILE HYDROCARBONS IN WASTE OIL

Type of hydrocarbons	Number of isomers present
C_2 alkyl benzene	3
C_3 alkyl benzene	4
C_4 alkyl benzene	4
C_5 alkyl benzene	5
naphthalene	-
methylnaphthalene	1
C_2 alkyl naphthalene	2

Table 1. General Characteristics of the Selected Waste Oil Composite

Waste Oil Characteristics	Concentration on Measured Value
INSPECTION TESTS FOR LUBRICATING OILS[a]	
SP. GR. (60/60°F)	0.906
Viscosity	
A. SUS 100°F	290
B. SUS, 210°F	60.9
Viscosity Inoex	170
Carbon Residue (percent)	4.3
Flash Point (°F)	138
Nitrogen (percent)	0.090
Sulfur (percent)	0.54
BS&W (Percent)	1
Pentane Insoluble (percent)	2
Antifreeze (percent)	<0.1
Safonification N.	14.5
Gasoline Dilution	3.2
Total Acid No.	2.91
Total Base No.	2.06
Particulate (percent)[b]	15.6
Pentane Insolubles (percent)	3.2
Coagulated Pentane Insoluble (percent)	11.1
Benzene Insoluble (percent)	1.45
Coagulated Benzene Insoluble (percent)	1.85
CONCENTRATION OF METALS (ug/gm)[a]	
Aluminum	15
Copper	18
Iron	220
Lead	18,500
Nickle	0
Silicon	17
Antimony	6
Vanadium	0
Sodium	59
Barium	177
Calcium	688
Zinc	1350
Magnesium	410
CLASSES OF ORGANIC COMPOUNDS[b]	
Saturated Hydrocarbons (percent)	76.6±1.0
Aromatic Hydrocarbons (percent)	4.1±0.1
Polar Compounds (percent)	3.8±0.6
Volatile Hydrocarbons (percent)	3.2

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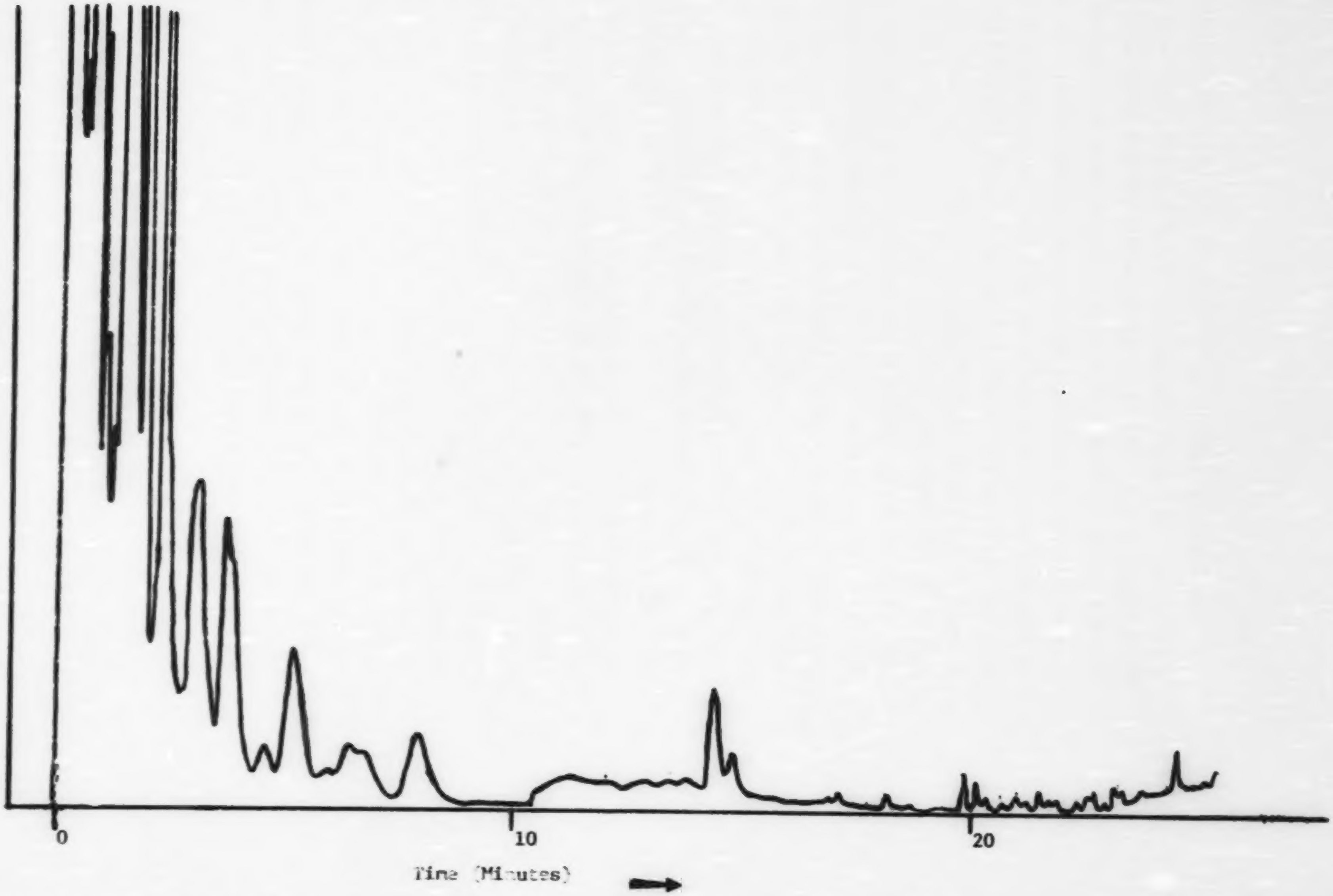
[a] Analyses conducted at Bartlesville Energy Research Center, U.S. Bureau of Mines.
[b] Analyses conducted at the National Water Quality Laboratory.

Figure 1. FID Trace of Volatile Compounds in Waste Oil.
(Programmed from 50°C. to 100°C.)



The nonvolatile components of the waste oil were fractionated on silicic acid and shown to contain 76.6 ± 1.0 percent saturated hydrocarbons, 4.1 ± 0.1 percent aromatic hydrocarbons, 3.8 ± 0.6 percent polar compounds, and 15.6 ± 2.0 percent particulate materials. The particulate fraction contained solids presumed to be metal particles which settled slowly in the waste oil but were more rapidly removed when the oil was diluted with two volumes of hexane to decrease the viscosity.

B. Saturated Hydrocarbons

The saturated hydrocarbons comprised the largest fraction of the waste oil selected for this study (76 percent). Figure 2 presents a chromatogram of this fraction which shows that the fraction consists of a complex mixture of normal and non-normal hydrocarbons. Because of this complexity, the individual components cannot be separated by packed GLC columns and detailed identification of the mixture is precluded. However, the range of molecular size of the hydrocarbons as expressed by carbon number can be estimated by the GLC retention time relative to normal hydrocarbon standards. As indicated in Figure 2, carbon numbers of the major saturated hydrocarbons range from about 20 to 29 carbon atoms per molecule, with distribution centering around the 24 carbon molecules.

C. Aromatic Hydrocarbons

The waste oil contained only four percent aromatic hydrocarbons. Figure 3 is a chromatogram of the aromatic fraction and, in contrast to that of the saturated hydrocarbon fraction, a series of discrete components were resolved by GLC. Figure 4 illustrates the use of computer-reconstructed mass chromatograms of the early-eluting aromatic components. The mass intensities plotted as a function of elution time (spectrum number, i.e. seven seconds per spectra) are M/e 106, 120, 134 which are the molecular ions for C_2, C_3, and C_4 alkylbenzenes, respectively. These GC/MS techniques produced tentative identifications for approximately 30 aromatic hydrocarbons in the aromatic fraction

Figure 2. FID Trace of Aliphatic Compounds in Waste Oil

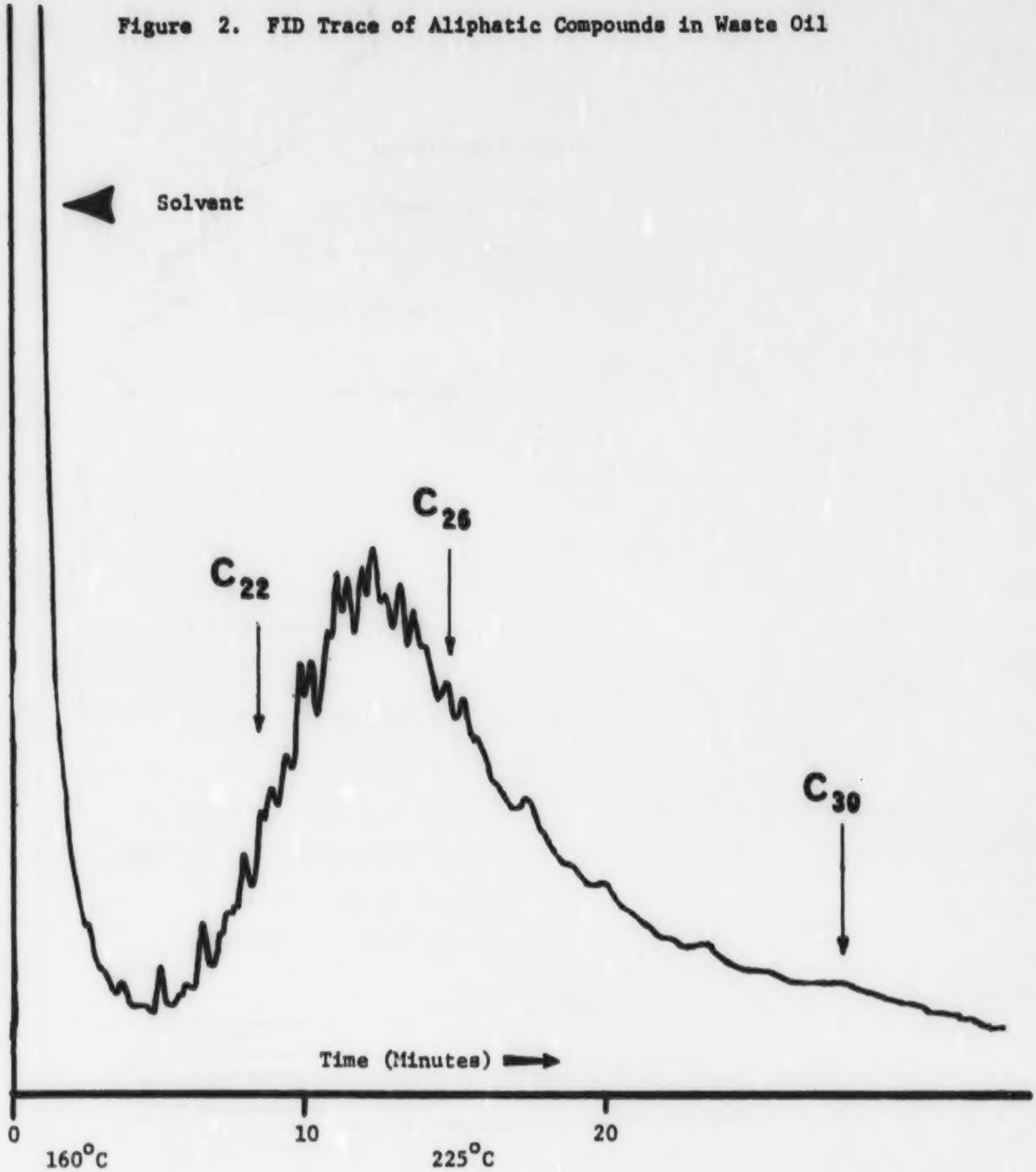
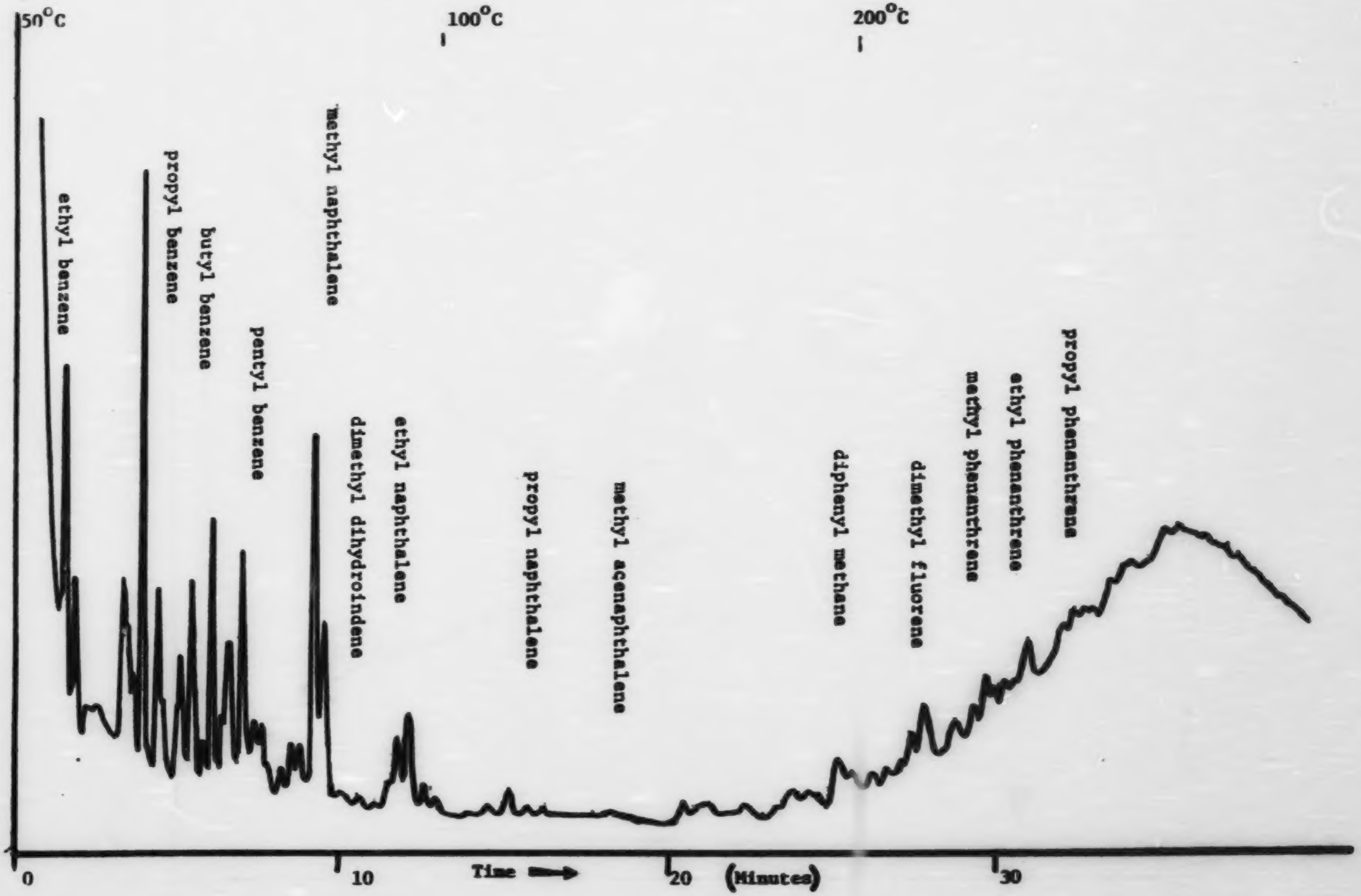


Figure 3. FID Trace of Aromatic Coumpounds in Waste Oil



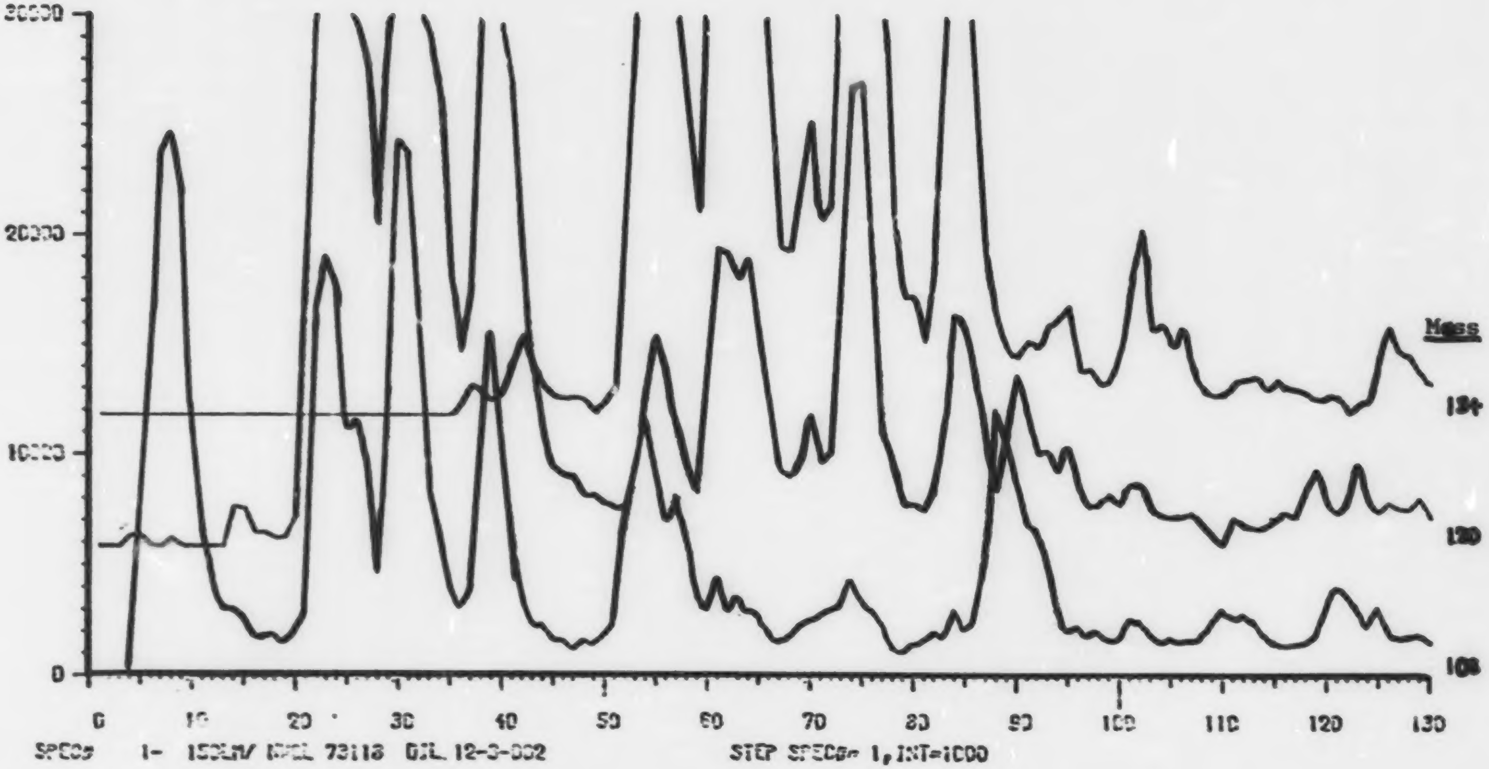


Figure 4. Molecular Ion Plots of the First 10 Minutes of the Aromatic Fraction Chromatogram.

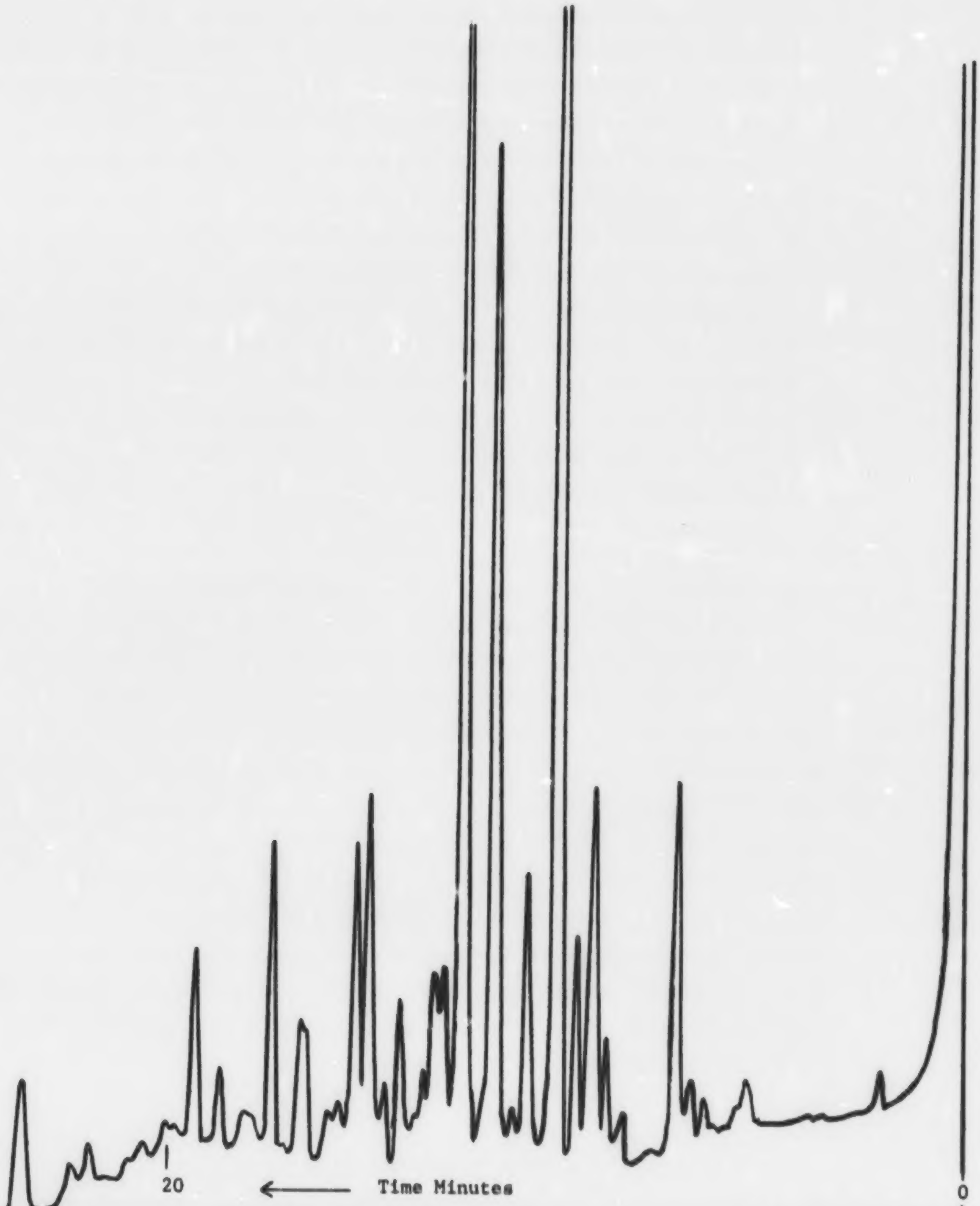
of the waste oil. Table 3 presents a list of these chemicals and the number of isomers of each type identified.

Table 3. MAJOR AROMATIC COMPONENTS IN THE WASTE OIL

Type of hydrocarbons	Number of isomers present
ethylbenzene	1
C_3 alkyl benzene	3
C_4 alkyl benzene	4
C_5 alkyl benzene	4
naphthalene	-
methylnaphthalene	2
C_2 alkyl napthalene	2
C_3 alkyl napthalene	2
phenanthrene	-
methylphenanthrene	2
C_2 alkyl	2
C_3 alkyl	2
dihydrodimethylphenanthrene	-
dihydrodimethylindene	-
diphenylmethane	-
ethylstyrene	-

D. The polar chemicals are generally thought to be those chemicals which contain atoms other than carbon and hydrogen in the molecule. Since the oil contains about 1.9 percent lead and organo-lead components such as lead dialkyldithiocarbamates are often used as motor oil additives in concentrations of one to five percent, it is probable these additives comprise a substantial part of the polar compounds and an investigation of possible organo-lead compounds has begun.

Figure 5. FID Trace of Acidic Compounds Found in Waste Oil



Other polar chemicals are likely to be the acidic and phenolic oxidation products which form in the internal combustion engine. A study of acids and phenols was begun by extracting those classes of chemicals from the oil with strong base. The extracted chemicals were converted to methyl esters using a variety of methylating reagents and examined by GLC and GC/MS. Figure 5 is a chromatogram of the methylation products of the waste oil which indicates that there are nine major and six minor esters in this fraction. Figure 6 shows several spectra of the components of the ester mixture which indicate that the components have similarities and may represent a homologous series. For example, all components have odd masses for predominant ions and it is likely the heaviest major ion is not the parent ion. Moreover, the heaviest major ion in the last two spectra differ by 14 mass units which suggests two similar compounds differing only by one methylene group (one carbon number).

II. Characterization of the Water Soluble Fraction Stock Solution

Composition of the water soluble fraction was found to be considerably different from that of the waste oil. The waste oil contained 76 percent saturated hydrocarbons but the water soluble fraction stock solution contained only 3.2 percent saturated hydrocarbons. Conversely, the polar components accounted for only 4 percent of the waste oil but 82 percent of XAD-2 extractable residue in the water soluble fraction. The aromatic hydrocarbon content increased from 4.1 percent in the waste oil to 14.5 percent in the water soluble fraction. Although the magnitude of changes in composition could not be predicted becasue of the complexity of the mixtures, the general trend of the more water soluble components being enriched in the water soluble fraction is expected.

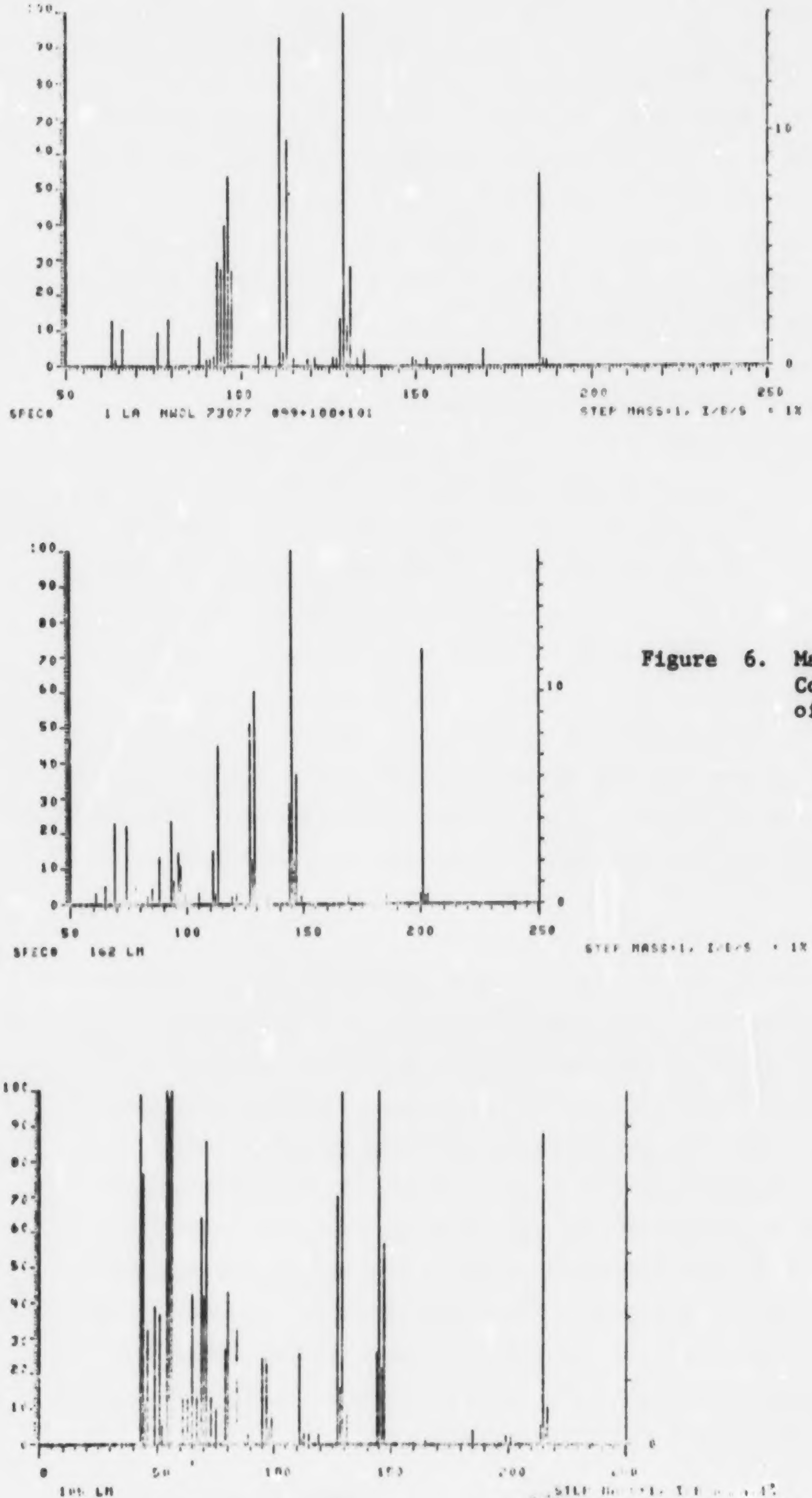


Figure 6. Mass Spectra of Three Compounds in the Base Wash of Waste Oil.

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A. Saturated Hydrocarbons

It was anticipated that the mixture of saturated hydrocarbons would behave similar to many other lipophilic compounds in the bioassay system in that the mixture would be partitioned in the fish lipids in approximately the same proportions occurring in the test water. Therefore, the saturated hydrocarbon fraction in the wastes was examined by GLC to estimate a total saturated hydrocarbon concentration and possible compositional changes. Using the saturated hydrocarbon fraction from the waste oil as a standard, the concentration of the total saturated hydrocarbon concentration in the bioassay system should be 0, 2.5, 4.9, 10, 41 and 94 ug/l in the six tanks. The composition of the saturated hydrocarbon mixture was examined by GLC and shown to be slightly enriched with respect to the normal hydrocarbons. Figure 7 is a chromatogram of the mixture which shows that the normal hydrocarbons are readily discernible in the mixture in the water, whereas they could not be distinguished from the non-normal compounds in the oil. GC/MS analysis confirmed the FID chromatogram in Figure 7 and verified that the overal distribution of hydrocarbons (carbon number range and mode) was similar to that in the waste oil.

B. Aromatic Hydrocarbons

The percentage aromatic hydrocarbons increased from 4 percent in the oil to 14 percent in the stock solution. The aromatic fraction of the XAD residue from the water was examined by GC/MS to determine possible compositional changes. The data indicated that although there was a three-fold enrichment of aromatic compounds in the stock solution, the concentration of the higher molecular weight compounds (three ring polyaromatic hydrocarbons) was diminished to below the detectable limit in this preliminary analysis. The major aromatic components in the water included the same alkyl benzenes and naphthalenes as the waste oil. Table 4 compares the major components in the stock solution with those in the waste oil.

Figure 7. FID Chromatogram of XAD Extract From Water Soluble Fraction of Waste Oil

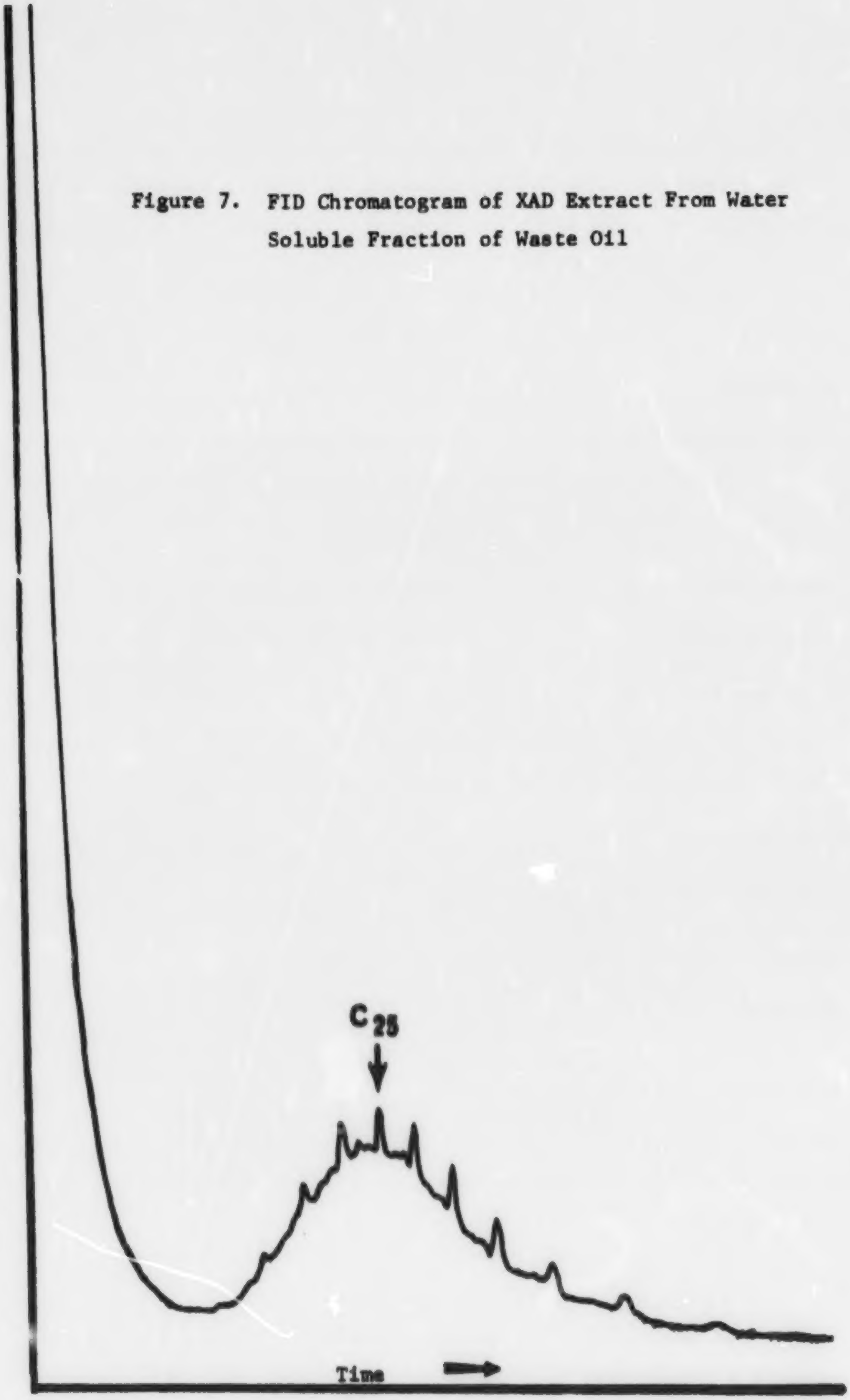


Table 4. SUMMARY OF AROMATIC HYDROCARBONS IN WASTE OIL AND WATER SOLUBLE FRACTION

Aromatic compounds in waste oil		Aromatic compounds in water soluble fraction	
Compound	No. of isomers	Compound	No. of isomers
C_2 alkyl benzene	3	C_2 alkyl benzene	3
C_3 alkyl benzene	3	C_3 alkyl benzene	2
C_4 alkyl benzene	4	C_4 alkyl benzene	2
C_5 alkyl benzene	4	C_5 alkyl benzene	3
naphthalene	-	naphthalene	-
methyl naphthalene	2	methyl naphthalene	2
C_2 alkyl naphthalene	2	dimethyl indene	-
C_3 alkyl naphthalene	2		
phenanthrene	-		
methyl phenanthrene	2		
C_2 alkyl phenanthrene	2		
C_3 alkyl phenanthrene	2		
dihydrodimethyl-phenathrene	-		
dihydrodimethyl-indene	-		
diphenyl methane	-		
ethyl styrene	-		

C. Polar Compounds

The polar fraction of the water soluble fraction stock solution has not been examined extensively, but has been analyzed for the possible presence of chlorinated industrial compounds such as solvents, PCB's or related chemicals. A PCB mixture similar to Aroclor 1254 (Monsanto) was found in the waste oil but was less than in the stock solution. A study of the possibility that the major components in the polar fraction are organic lead additives to the oil is planned. Since the oil contains 1.9 percent lead, the percent of a lead additive such as lead oleate would be approximately 4.0 percent. The measured polar fraction of the oil was 3.8 ± 0.6 percent, which suggests the residue may be an organo lead compound such as the oleate. Moreover, the experiments using the XAD resins to remove organic material from the stock solution showed that greater than 90 percent of the lead in the stock (≃ 4.4 mg/l) was removed by the XAD column indicating an organic form of lead.

D. Metals

Results of preliminary screening of two water soluble fraction stock samples for several metals are given in Table 5. Comparisons of the two methods for cadmium and lead analyses on tissue and water samples agreed to within experimental error, which was typically ≤ ± 10% relative. Mercury was analyzed by a conventional flameless vapor technique (National Water Quality Laboratory unpublished data; Hatch and Ott, 1968). Judging from past data on water quality and considering that the nominal high exposure concentration was one percent it was predicted that likely metals to be of concern were cadmium, lead and zinc. This evaluation prompted further studies to be focused more on these metals.

Filtration studies with the stock solution indicated that greater ≥ 90% of the lead, zinc and cadmium was in the "dissolved fraction". The term "dissolved fraction" refers to components 0.05 microns

Table 5. METALS IN WATER SOLUBLE FRACTION STOCK SOLUTION

Metal	Concentration ug/l	Atomic Absorption method
Mercury	< 0.1	Flameless vapor
Cadmium[a]	60 ± 2	Flameless
Molybdenum[a]	< 200	Flameless
Cobalt[a]	0.4 ± .4	Flameless
Arsenic[a]	< 300	Flameless
Selenium[a]	< 100	Flameless
Chromium	< 140	Flame
Nickel	< 100	Flame
Iron	< 100	Flame
Manganese	< 100	Flame
Copper	< 100	Flame
Lead	4400 ± 200	Flame
Zinc	16000 ± 1000	Flame

[a] Does not necessarily include any possible contribution from a highly volatile metal fraction.

and smaller. However, due to the fact that there is essentially no difference ($\leq$ 10%) between the unfiltered water soluble fraction and the various pore size filtrates, in addition to the fact that 0.05 microns is in the middle of the colloidal range, it is possible that the major portion of these metals is in true solution. Further studies of possible metal ion complex states would be a valuable characterization.

I. Residues in Fish Exposed to Water Soluble Fractions of Waste Oil

The residues in the exposed fish were examined for hydrocarbons by determining the weight of chemicals which are stable to fuming H_2SO_4 as well as by those evidenced by GLC. The results of these analyses together with the PCB analyses are presented in Table 6.

The data indicate that there is some reduction of weight of the fish sampled after about 45 days of exposure in that the average weight of all control fish was about 330 mg but the average weight of the fish from the highest concentration of the stock solution (1.0 percent nominal) was only 220 mg. The fish from the highest test concentration also contained 28 percent less total lipids than the control fish, although there is not a discernible trend at the other exposure concentrations.

The range of PCB concentrations expressed as Aroclor 1254 for all fish was 0.43 to 0.66 ug/gm. These concentrations are comparable to other control fish at NWQL and likely results from minor food and/or water contamination rather than from the small amount of PCB's in the oil. No relationship between exposure level and PCB residues exists for this oil.

The hydrocarbon residue stable to fuming H_2SO_4 ranged from 200 to 1000 ug/gm; however, the concentration of this class of chemicals was highly variable and the exposure to the water soluble fractions did not appear to have effect on the concentration of stable hydrocarbons in the fish. Equally unanticipated was the fact that the fish from the control tanks contained approximately 300 ug/gm of these stable hydrocarbons. Thus, more detailed studies of the hydrocarbon residue were necessary to adequately assess the

Table 6. SUMMARY OF RESIDUE ANALYSIS FOR FIRST 45 DAYS OF JORDANELLA CHRONIC EXPOSURE TO THE WATER SOLUBLE FRACTION OF WASTE OIL

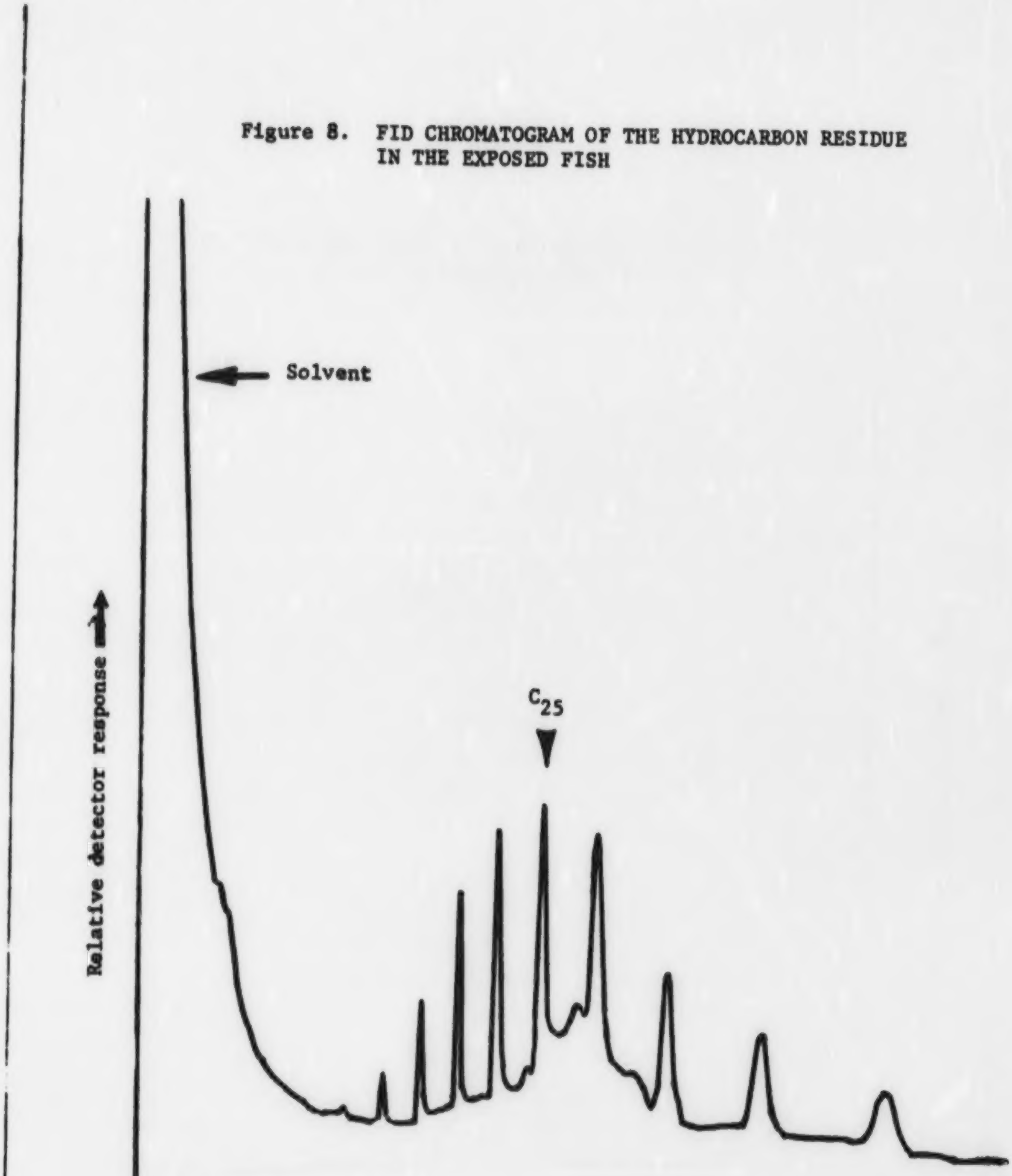
Measured water concentration of water soluble fractions (% of stock solution)		Number of fish in composite	Mean weight (gm) [S.E.]	Lipid (percent)	PCBs A-1254 (ug/gm-wet)	PCBs A-1254 (ug/gm-lipid)	Hydrocarbon residue[a] (ug/gm-wet)	Hydrocarbon residue[a] (ug/gm-lipid)	N-hydrocarbon[b] (ug/gm-wet)	N-hydrocarbon (ug/gm-lipid)
fish 45-day exposure	Eggs until hatched									
Control	0.77	16	0.32[0.01]	3.7	0.43	11.6	310	8,400	0.29	7.8
Control	0.77	20	0.27[0.02]	4.3	*	*	*	*	0.26	6.0
Control	Control	14	0.31[0.04]	5.5	0.50	9.1	340	6,100	0.48	8.7
Control	Control	9	0.42[0.04]	5.2	0.45	8.6	230	4,400	0.33	6.3
0.02	0.08	18	0.26[0.02]	6.7	0.66	9.8	1,000	14,900	0.77	11.5
0.02	Control	14	0.38[0.04]	7.1	0.57	8.0	340	4,800	0.77	10.8
0.02	Control	15	0.33[0.02]	5.6	0.45	8.0	220	3,900	0.18	3.2
0.02	0.08	16	0.23[0.02]	6.4	0.45	7.0	510	8,000	1.94	13.3
0.04	0.34	15	0.25[0.03]	6.7	0.52	7.8	400	6,000	1.24	13.5
0.04	Control	14	0.28[0.03]	6.5	0.64	9.8	510	7,800	1.64	25.2
0.04	Control	10	0.36[0.03]	6.5	0.74	11.4	290	4,500	0.29	4.5
0.04	0.34	16	0.29[0.03]	6.9	0.58	8.4	330	4,800	1.10	15.9
0.08	Control	15	0.27[0.02]	6.5	0.60	9.2	630	9,600	1.94	29.8
0.08	0.77	17	0.30[0.02]	4.1	0.44	10.7	200	4,900	1.14	27.8
0.08	0.77	17	0.26[0.02]	6.5	0.60	9.2	340	5,200	1.61	24.8
0.34	0.08	15	0.25[0.02]	5.7	0.65	11.4	390	6,800	1.61	28.2
0.34	0.34	7	0.31[0.04]	6.5	0.44	6.8	280	4,300	0.44	6.8
0.77	0.08	12	0.22[0.02]	3.5	0.44	12.6	570	14,500	0.37	11.6
0.77	0.34	17	0.21[0.02]	3.2	*	*	*	*	0.62	17.7

[a] Hydrocarbon residue is defined as the residue which is stable to fuming H_2SO_4

[b] Estimated N-hydrocarbons = (Σ Peak height of N-hydrocarbons in sample) X ug/mm for pentacosane internal standard. Although this term represents a relative mass, the upper bound for the concentration of N-hydrocarbons is the hydrocarbon residue. There is no discernible relationship between the hydrocarbon residue and the relative N-hydrocarbon residue due, in part, to non-normal hydrocarbons from the brine shrimp food.

*No data - these samples prepared by Florisil cleanup for N-hydrocarbon analysis.

Figure 8. FID CHROMATOGRAM OF THE HYDROCARBON RESIDUE IN THE EXPOSED FISH



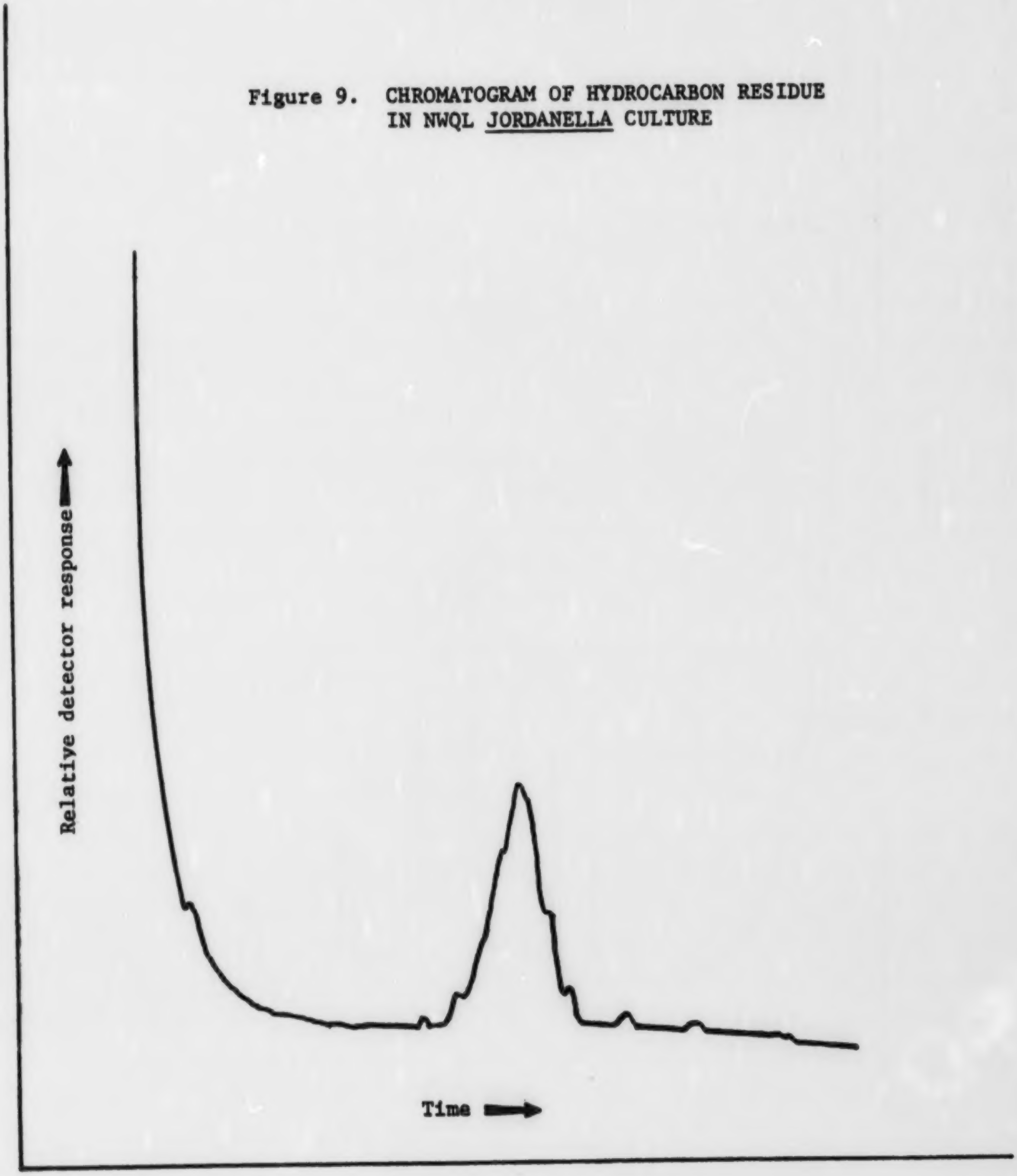


Figure 9. CHROMATOGRAM OF HYDROCARBON RESIDUE IN NWQL *JORDANELLA* CULTURE

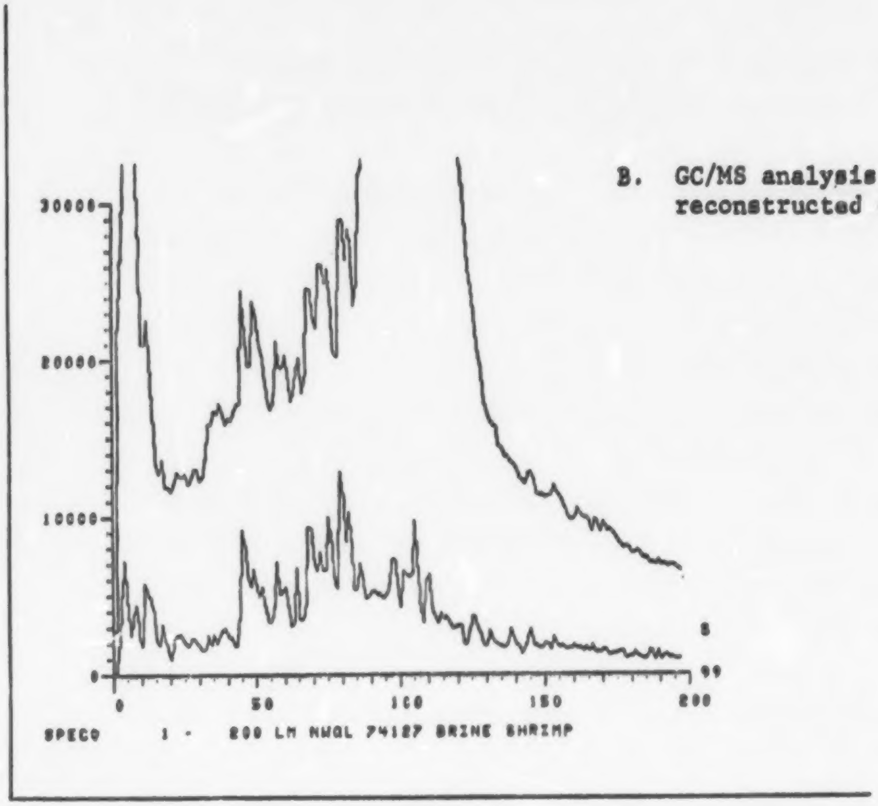
relationship of the hydrocarbons in the water and those in the fish.

The residues were anlyzed by GLC in an effort to better quantitate the hydrocarbon residues. Figure 8 is a chromatogram of a typical fish extract and shows that the hydrocarbon mixture in the fish bears little resemblance to that in the water (Figure 7), and that a remarkable enrichment in the normal hydrocarbons occurred. The distribution of the normal hydrocarbons (i.e., distribution of carbon numbers) is essentially the same as that in the toxicant stock solution; however, the complex mixtures of branched chain hydrocarbons and polynuclear aromatic hydrocarbons are either absent or greatly diminished.

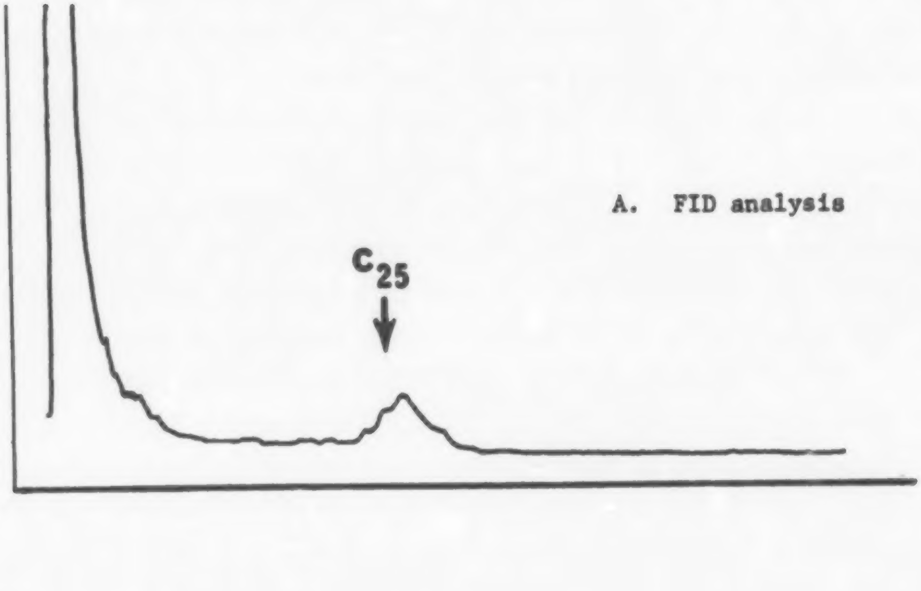
The usual group of compounds eluting with the C_{25} hydrocarbons suggested small amounts of branched compounds but the contribution of this group to the total residue was not consistent among the fish and had no relationship to exposure level. It was this group of compounds which undoubtedly made the earlier hydrocarbon residue determination meaningless. Fish from the NWQL culture stock which are totally isolated from the waste oil bioassay were analyzed to determine if similar stable compounds were present in this species of fish. Figure 9 is a chromatogram of the culture stock fish which shows the presence of the unidentified group of chemicals as well as small amounts of normal hydrocarbons. These findings were confirmed by GC/MS; however, the composition of the mixture has not yet been identified.

The similarity of residues in these fish from two different sources suggests the compounds are of biogenic origin or that there was a common source of contamination. To investigate the latter possibility, the brine shrimp which is the primary food was analyzed. Figure 10a is a FID chromatogram of the shrimp extract showing the presence of the components common to the two different groups of fish. Figure 10b is a computer reconstructed chromatograph from the GC/MS analysis confirming the presence of the unknown group,

Figure 10. GLC ANALYSIS OF BRINE SHRIMP



B. GC/MS analysis
reconstructed chromatogram



A. FID analysis

but indicating that the mixture of normal hydrocarbons detected by the M/e 99 plot is not present in the brine shrimp.

The problem of distinguishing the hydrocarbons in the fish tissue originating from the waste oil toxicant from those from other sources was remedied by determining the concentration of only the normal hydrocarbons in the fish. Because the residue involves many normal hydrocarbons, the estimate was made (Table 6) by summarizing the peak heights of the major normal hydrocarbons and calculating an equivalent mass using pentacosane (the median hydrocarbon in the distribution). This estimate of normal hydrocarbons appears in Table 6 expressed as ug/gm on a wet tissue basis and on a lipid basis.

The dependence of the normal hydrocarbon residue on the concentration of saturated hydrocarbons in the water is demonstrated in Figure 11. The linear line was drawn through the data, neglecting the outlying points and assuming the fish have reached a steady state with respect to the uptake and elimination of the hydrocarbons. The slope of the line is approximately 2,000 which is the bioaccumulation factor expressed as normal hydrocarbons in fish to total saturated hydrocarbons in water. This factor is much smaller than other lipophilic chemicals such as pesticides ($\gtrsim 10^5$); however, the estimated factor for normal hydrocarbons in the fish must be related to normal hydrocarbons in the water to be directly comparable. This has not been achieved because of the difficulty in quantitatively separating normal hydrocarbons from branch hydrocarbons with chemical techniques.

A summary of metal tissue residue analyses of whole fish for lead, zinc and cadmium is given in Table 7 and Figure 12. Percent recoveries for known amounts of metal added to 0.02 - 0.3 gm fish samples were generally 100 ± 15% for cadmium, lead and zinc. Reagent blank values were generally below those of the sample by a factor of 10 to 1,000. Samples were reported "less than" if the reagent blank was greater than or equal to one-half the sample value.

Figure 11. RELATIONSHIP BETWEEN N-HYDROCARBONS IN FISH AND THE TOTAL HYDROCARBONS IN THE WATER.

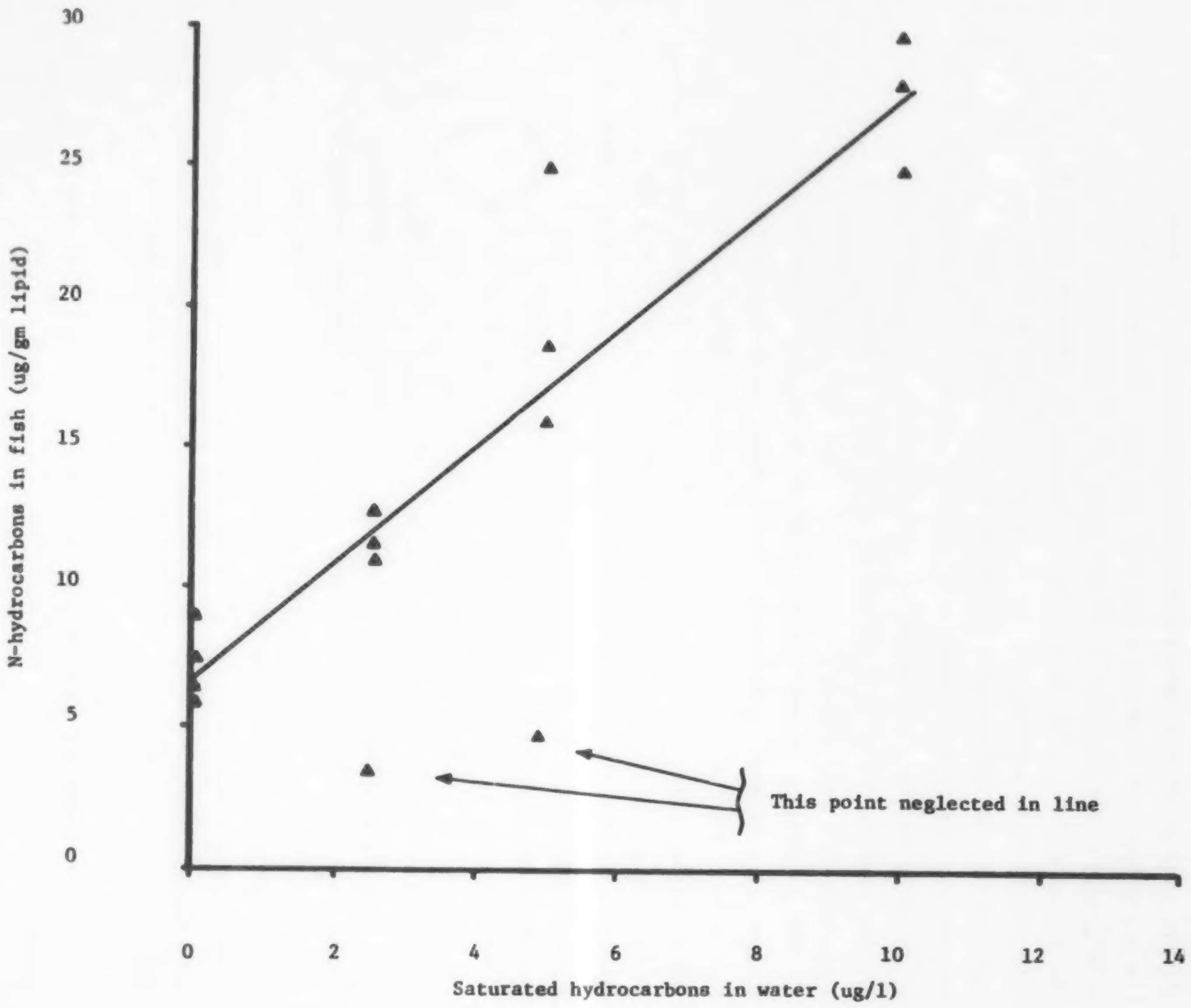


Table 7. METALS RESIDUES IN WHOLE JORDANELLA FLORIDAE TISSUES

Measured toxicant concentration (%)	Exposure time (days)	Metal residue[a] (ug/gram, dry wt.) Lead	Cadmium	Zinc
Control	30	<1.3	0.11 ± .03	119 ± 11
	75	1.4[c]± .2	0.30[c] ± .03	99[c] ± 10
0.015	30	1[c] ± 1	0.15[c] ± .04	146[c] ± 15
	75	1.3[c] ± .2	--	102[c] ± 10
0.33	30	25 ± 4	1.1 ± .2	187 ± 18
	57[d]	22 ± 2	0.92 ± .2	143 ± 15
0.80	30	40[c] ± 4	1.2[c] ± .1	256[c] ± 25
	64[b,d]	50 ± 10	1.3 ± .2	291 ± 25

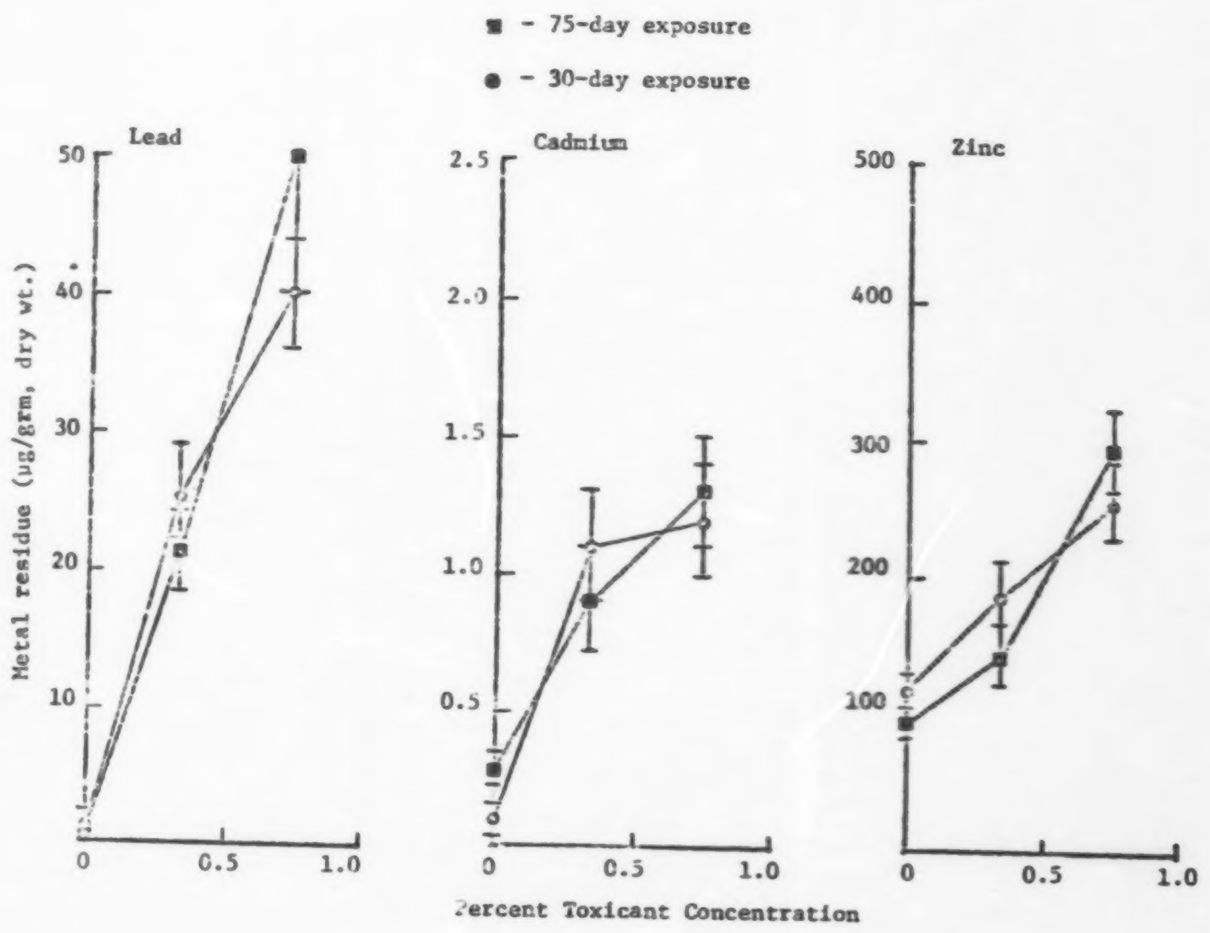
[a] Averageof atleast duplicate digestions of a two-fish composite per digestion.

[b] Average of three 64-day samples and one 75-day sample of two-fish composits.

[c] Based on a single digestion of a two-fish composite.

[d] Value plotted as a 75-day exposure.

Figure 12. CORRELATION OF METAL RESIDUES IN WHOLE _JORDANELLA FLORIDAE_ TISSUE WITH TOXICANT CONCENTRATION



Results correspond to essentially two exposure times and three different exposure concentrations plus controls. From the data, it is obvious that all three metal residue levels are substantially higher for both exposure times and the 0.75% and 0.31% exposure concentrations. For lead and zinc, residue levels vary almost linearly with concentration. However, with cadmium there appears to be a leveling off effect. For all three metals there appears to be little difference in residues between 30-day and 75-day exposure fish. If one assumes that an equilibrium has been attained, the corresponding dry weight bioaccumulation factors for the longest exposed fish are 1.5×10^3, 2.9×10^3 and 1.6×10^3 for lead, cadmium and zinc, respectively. This bioaccumulation is in direct accord with past residue data on cadmium and lead (National Water Quality Laboratory unpublished data), however, exact comparisons were not made due to some experimental procedural differences.

Biological Tests

The 96-hour LC50's for the static tests were as follows: water soluble fractions with Jordanella floridae, 3.8% by volume of water soluble fraction stock solution (0.38% by volume total oil) and layered oil with Pimpehales promelas, 1.1% by volume total oil. The 96-hour LC50 for emulsified oil was .037% by volume total oil. The 96-hour LC50's for flow-through tests with water soluble fractions were 1.0% and 1.6% by volume of stock solution (0.1 and 0.16 percent by volume total oil) for Jordanella and Pimephales, respectively. LC50's were estimated for this report by straight line graphical interpolation as described in Standard Methods for the Examination of Water and Wastewater (1971). Estimations of LC50's were made using pooled mortality data from duplicate exposure levels. Variations between duplicate tanks in acute tests based on lead analyses were 6% or less (Table 8). Since the oil was added volumetrically in the static tests, it was felt that nominal concentration was acceptable accuracy for calculating LC50's.

Table 8. CONCENTRATIONS OF OIL MEASURED DURING ACUTE AND CHRONIC EXPOSURES AS DETERMINED BY LEAD AND ZINC

A. Water soluble fraction flow-through tests with Jordanella Floridae and Pimephales promelas.

Nominal test concentration (in % of stock solution)	Measured soluble fraction oil concentrations (in % stock solution)		
	Lead[a]		
	Mean	Range	Zinc[b]
5.0	4.54 ± .44	4.05-5.11	4.63
5.0	4.56 ± .32	4.33-5.11	4.69
2.5	2.21 ± .20	1.90-2.19	2.20
2.5	2.25 ± .11	2.12-2.34	2.30
1.25	1.05 ± .08	0.95-1.12	1.10
1.25	0.99 ± .15	0.78-1.12	1.09
0.63	0.54 ± .03	0.49-0.57	0.59
0.63	0.55 ± .04	0.49-0.58	0.60
0.32	0.25 ± .01	0.24-0.25	0.28
0.32	0.23 ± .02	0.20-0.25	0.28
0.00	0.004 ± .005	0.000-0.009	0.00
0.00	0.004 ± .004	0.010-0.000	0.00
Stock solution (μg/l)	6,650 ± 974	5,670-8,180	24,700

[a] Five measurements.

[b] One measurement only

B. Layered oil acute static test with *Jordanella floridae*.

Nominal concentration (% oil by volume)	Measured lead (μg/l) after 5 days
4.0	919
4.0	881
2.0	675
2.0	713
1.0	478
1.0	497
0.50	350
0.5	350
0.25	217
0.25	211
0.00	3
0.00	0.0

C. Water soluble fraction chronic test with *Jordanella floridae*.

Nominal concentration (% of stock solution)	Measured lead concentration (µg/1) $\overline{X}$	Range	Number analysis	% Stock solution based on $\overline{X}$ lead concentration	Total oil required[a] (µl/1)
1.0	37.0 ± 8.3	22.7–56.0	23	0.792	792
1.0	38.7 ± 8.5	24.8–55.1	21	0.829	829
0.4	16.0 ± 3.9	7.33–23.4	22	0.343	343
0.4	15.5 ± 4.2	7.22–23.8	20	0.332	332
0.16	4.50 ± 1.94	2.68–11.8	22	0.096	96
0.16	4.22 ± 1.47	2.52–8.42	21	0.090	90
0.064	1.56 ± .467	1.03–2.65	21	0.033	33
0.064	1.48 ± .346	0.98–2.54	20	0.032	32
0.026	.770 ± .340	0.30–1.97	22	0.016	16
0.026	.706 ± .237	0.32–1.29	21	0.015	15
0.00	.187 ± .189	0.01–0.64	23	0.004	4
0.00	.147 ± .141	0.01–0.60	21	0.003	3
Stock solution	4670 ± 750	3440–6610	30		

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[a] Based on stock solution prepared from 10% oil in water.

The difference between the layered and dissolved oil acutes may be a matter of solubility rate. The dissolved oil tests began with the toxic compounds in the water. However, the amount of toxic compounds in the water from an oil layer is at least partially a function of oil and water contact time. Thus in a four day period, all the toxic components may not have leeched into the test water. This also can account for the non-linear relationship of nominal concentration and lead concentrations in the layered oil test. Additional factors could be a delay in response of the fish to the toxicant and the loss of volatile components due to aeration.

The results of the routine chemical analysis for acute tests are reported in Table 9. In general, the addition of waste oil caused a lowering of pH and dissolved oxygen concentration and an increase in acidity. The dissolved oxygen concentration was greater than 60% saturation in all tests except the high concentration in the water soluble fraction static. At this concentration, the dissolved oxygen concentration dropped to 53% saturation.

Since the chronic exposure was not completed at the time of the report preparation, complete analysis of the lead monitoring data has not been presented. The data available is reported in Table 8. Results of routine chemical analysis for the chronic test, however, were not available upon report preparation.

Preliminary biological data available from the Jordanella chronic test are reported in Tables 10 and 11. The egg production and fry transfer data suggests that the "no effect" level is between 0.08 and 0.33 percent by volume of the water soluble fraction stock solution. Since the stock solution is derived from 10% oil in water, the effect level, assuming total removal of soluble components from the oil, is approximately 0.031% by volume or 310 μl/1 total oil. Using this extrapolation sets an upper boundary of acceptable total oil levels. An estimate of the lower boundary may be made by calculating the quantity of oil required to produce the concentration of lead previously found to be chronically toxic. Assuming total availability of the lead in the oil (18,500 mg/1) and an effect level of 125 μg/1 lead (NWQL report, in preparation), the effect level for oil would be 8 μl/1.

Table 9. ROUTINE CHEMICAL ANALYSES FOR ACUTE TEST WATERS

Chemical parameter	Layered oil static test with *Pimephales* (% oil)		Water soluble fraction static test with *Jordanella* (% stock solution)			Water soluble fraction flow through tests with *Jordanella* and *Pimephales*[a] (% stock solution)				
	4.0	0.0	10.0	2.5	0.0	5.0	2.5	1.25	0.62	0.0
pH										
Day 1	7.56	7.86	7.43	7.52	7.79	7.47	7.61	7.56	7.71	7.76
Day 4	7.45	7.80	7.28	7.48	7.80	(4)	(1)	(2)	(3)	(3)
Acidity (mg/l)										
Day 1	2.45	1.47	3.43	2.45	1.96	4.66	6.37	2.74	2.61	1.96
Day 4	3.43	1.96	6.32	3.43	1.96	(4)	(1)	(2)	(3)	(3)
Hardness (mg/l as $CaCO_3$)										
Day 1	46	45	46	46	43	47	47	45	45	44
Day 4	46	47	46	45	44	(3)	(1)	(2)	(3)	(3)
Alkalinity (mg/l as $CaCO_3$)										
Day 1	43	45	43		45	43	43	43	43	43
Day 4	42	44	42		45	(3)	(1)	(2)	(3)	(3)

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[a] Mean value (number of samples)

Table 10. SURVIVAL, GROWTH, AND REPRODUCTION OF *JORDANELLA FLORIDAE* IN THE CHRONIC EXPOSURE

Nominal oil concentration (% stock)	Females			Males			Total eggs produced	Eggs per female	Hatchability		
	Number alive	Mean weight (gm)	Mean length (cm)	Number alive	Mean weight (gm)	Mean length (cm)			Range % hatch	Mean % hatch	Number Tests
1.00	5	0.4321	2.4	3	0.9786	3.0	3	0.6	--	--	0
1.00	5	0.8597	3.1	2	1.3074	3.4	53	10.6	--	--	0
0.40	4	0.8455	2.8	3	0.8642	3.0	110	27.5	67	67	1
0.40	4	1.2285	3.2	2	2.9183	4.5	5	1.25	--	--	0
0.16	5	0.9278	3.1	2	2.1099	4.1	973	194.6	28-100	58.3	9
0.16	3	0.8562	3.0	2	2.0118	4.0	603	201.0	43-76	61.7	3
0.064	5	1.0773	3.2	2	1.6142	3.7	2073	414.6	46-89	60.4	15
0.064	5	1.4393	3.5	2	1.4990	3.6	1424	284.8	32-82	59.0	9
0.026	6	1.0162	3.2	2	1.7650	4.0	1075	179.2	38-92	68.6	11
0.026	5	0.9018	3.1	2	1.9655	3.9	827	165.4	38-76	57.3	6
0.00	6	1.1021	3.4	2	2.1533	3.8	1957	326.2	18-96	46.5	8
0.00	5	0.9574	3.2	2	2.1380	4.2	1158	231.6	28-76	59.8	5

Table 11. THIRTY-DAY SURVIVAL OF ONE-DAY OLD *JORDANELLA FLORIDAE* FRY WITHIN THE SAME AND IN OTHER EXPOSURE TEST LEVELS

Nominal concentration for source of fry (% stock solution)	Nominal concentration for exposure to fry (% stock solution)	Mean % survival	Range % survival	Number tests
0.00	1.0	0.0	0-0	3
	0.4	1.7	0-6.7	4
	0.16	47.5	20-75	2
	0.064	86.7	80-93.3	2
	0.026	100	100-100	2
	0.00	73.8	40-100	8
0.026	1.00	1.25	0-5	4
	0.40	0	0-0	5
	0.16	23.3	6.7-53.3	3
	0.026	79.2	45-100	6
0.064	1.00	0.8	0-5	6
	0.40	53.3	40-80	3
	0.16	81.0	78.6-83.3	2
	0.064	78.6	45-100	6
0.16	1.00	24.3	0-86.7	5
	0.40	66.7	10-100	3
	0.16	76.0	60-90	5
	0.026	95.0	95-95	2
0.40	1.00	93.3	93.3	1
	0.40	83.3	65-95	3
	0.064	92.5	90-95	2
1.00	1.00	77.5	60-95	2
	0.16	97.5	95-100	2
	0.00	92.5	85-100	2

The fry survival data indicates that exposures of eggs allow the resultant fry to survive in some toxicant concentrations that are lethal to fry which hatched from unexposed eggs. Exposures of eggs to levels greater than 0.016 and 0.03% are necessary for fry survival in 0.33 and 0.81% by volume stock solution, respectively. At the 0.33 and 0.81% levels, however, reproduction was also inhibited, limiting the fish population at those concentrations to one generation.

A review of the identified compounds in the water soluble fraction stock, previous toxicity data, and tissue residue analysis, suggest that the metals zinc, lead, and cadmium probably account for the toxicity in the tests reported here. Chronic no effects levels, based on egg production, for zinc with Pimephales promelas in hard water (Brungs, 1969) and Jordanella floridae in soft water (Spehar, report in preparation) have been reported as less than 180 and 139 μg/l, respectively. In addition, Spehar (report in preparation) found that the 30-day LC50 for fish starting as one-day old fry was 58 μg/l for fry not exposed as eggs and 170 μg/l for fry exposed as eggs. Chronic no effect levels, based on deformities, for lead and brook trout, Salvelinus fontinalis (NWQL report in preparation) were reported as 125 μg/l. Cadmium no effect levels for Jordanella floridae have been determined to be less than 6-8 μg/l (Spehar, report in preparation) and less than 3 μg/l for brook trout (NWQL unpublished data). All these levels are within or close to the range of concentrations found in the waste oil tests. The effects of combinations of these metals has not previously been determined. However, Eaton (1973) in a chronic with Pimephales promelas and copper, zinc, and cadmium concluded that the mixture was little, if any, more toxic than the zinc component alone. The zinc concentration in Eaton's test at the no effect level, based on embryos per female, was less than 42.3 μg/l.

The fish tissue residue levels indicate that there was an accumulation of both persistent organics and metals. In addition to the metal toxicity values listed previously for aquatic organisms, toxicity levels, as reported by the Public Health Service, for some of the compounds identified in this study are listed in Table 12. Continual releases of waste oil in freshwater systems may result in a buildup of these toxic components. Fish subjected to this condition may, therefore, be more sensitive to additional stresses. Additional questions which were not addressed in the present study include the possibility of fish flavor impairment due to the organic components, the effects on organisms of waste oil hydrocarbons chlorinated during sewage treatment, the effects of waste oil on organisms other than fish, and the effects of waste oil surface films on surface exchange rates. Some of these problems will be investigated in the future.

Table 12. TOXICITY OF SOME COMPOUNDS FOUND IN WASTE OIL (FROM THE TOXIC SUBSTANCES LIST, 1973 ED., U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE, PUBLIC HEALTH SERVICE, NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH, ROCKVILLE, MARYLAND 20852)

Naphthalene (16282)		
TXDS	orl-rat	LD50=2200 mg/Kg
	ipr-mus	LDLo=150 mg/Kg
U.S.O.S.-air		FEREAC 37,22139,82
Xylene (24890)		
TXDS:	ihl-hmn	TCLo=200 ppm TFX=IRR
	orl-rat	LD50=4300 mg/Kg
U.S.O.S.-air		FEREAC 37,22139,72
Toluene (23487)		
TXDS:	ihl-hmn	TCLo=500 ppm TFX=CNS
	orl-rat	LD50=3000 mg/Kg
	ipr-rat	LD50=1640 mg/Kg
U.S.O.S.-air		FEREAC 37,22139,72
Phenanthrene (18120)		
TXDS:	orl-mus	LD50=700 mg/Kg
	skm-mus	TDLO=2160 mg/Kg 13WI TFX=NFO
Benzene, Ethyl (3039)		
TXDS:	occ-hmn	TDLo=200 ppm TFX=IRR
	orl-rat	LD50=3500 mg/Kg
Benzene, Propyl (3076)		
TXDS:	orl-rat	LD50=4830 mg/Kg
Cadmium as chloride (4793)		
TXDS:	orl-rat	LD50=88 mg/Kg
	scu-rat	TDLo=2.2 mg/Kg TFX=CAR
Lead as chloride (14128)		
TXDS:	orl-gpg	LDLo = 2000 mg/Kg
U.S.O.S.-air		FEREAC 37,22139,72
Zinc as chloride (24994)		
TXDS:	ivn-rat	LDLo = 75 mg/Kg
	par-ckn	TDLo = 1 mg/Kg TFX = NEO
U.S.O.S.-air		FEREAC 37,22139,72

SECTION VI

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APPENDIX D

EFFECTS OF EMULSIFIED WASTE CRANKCASE OIL ON SELECTED MARINE BIOTA

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Program Element 1BA022

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ABSTRACT

The acute toxicity of a waste oil, used crankcase oil, has been determined for a variety of marine organisms. The oil was not acutely toxic to two species of phytoplankton, *Skeletonema costatum* and *Thalassiosira pseudonana*, at levels up to 10 ppm. To *Acartia tonsa* it had a 96 hr. LC-50 of 15 ppm, but there was no apparent effect on *Tigriopis japonicus* at 50 ppm. Molluscan larvae were very sensitive to the oil, with levels of 1 ppm affecting coot clam larvae (*Mulinia lateralis*) and 4 ppm affecting oyster larvae (*Crassostrea virginica*). Also, lobster larvae (*Homarus americanus*) were sensitive, with a 96 hr. LC-50 of 5 ppm. *Menidia menidia*, an estuarine fish, was less sensitive, having a acute LC-50 of 1700 ppm.

From sub-acute studies it was determined that the oil causes morphological changes in *Menidia* as well as oyster and scallop. The oil was also shown to be toxic to scallop at 20 ppm after 20 days, and to oysters at 100 ppm after 36 days.

Neither the values obtained from the acute nor the sub-acute studies can be interpreted as safe lower levels in the environment. Such values must be based on more sensitive parameters than death and major morphological changes. They must include sublethal effects and community structure changes before the numbers can be considered as lower values for protecting the environment.

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Thanks are also due to George Gardner for conducting the fish bioassays and assistance in writing this report.

The histological examinations were handled by George Gardner for the fish, and by Paul Yevich for the molluscs and other invertebrates.

CONCLUSIONS

Emulsified waste oil, as exemplified by used crankcase oil, was demonstrated to be toxic to selected marine organisms. Emulsified waste oil concentrations lethal to 50% of the larval coot clam (Mulinia lateralis), oyster (Crassostrea virginica) and lobster (Homarus americanus) tested ranged between 1 and 5 ppm, while the toxicity to phytoplankton, zooplankton, and larval fish (Menidia) ranged from greater than 10 ppm to greater than 50 ppm. The toxic concentration acutely lethal to 50% of the adult Menidia tested for 96 hrs. was 1700 ppm. Based on the above, and other toxicity bioassays conducted at the National Marine Water Quality Laboratory, emulsified waste motor oil is not as toxic as crude oils, such as Texas-Louisiana crude, to marine phytoplankton, zooplankton, invertebrates and fishes. In comparison, refined crude oil, such as #2 fuel oil, is much more toxic than crude oil.

Waste motor oil caused vascular changes in adult oysters subjected to concentrations of 100 ppm and higher for exposure periods which ranged up to 36 days, while vascular alterations prevailed in adult Menidia at the lowest concentration tested (20 ppm) during exposures up to 60 days. Although the significance of these vascular alterations remains unknown, they have been consistantly observed in these two species when subjected to crude oil. Therefore, a morphological response pattern to petroleum products has now emerged.

It must be stressed that the concentation values reported herein are primarily for acute lethal responses or for major morphological changes. These values cannot be considered as lower levels which will protect the environment, for we have not considered sublethal or community structure effects. Therefore our values must be considered to be too high to ensure no long-term ecological damage.

RECOMMENDATIONS

Based on research conducted at the National Marine Water Quality Laboratory, and on information currently available in the literature for comparison, waste motor oil is not as toxic to marine biota as are either raw crude oil, or many of the products refined from crude oil. Knowledge about the toxic effects of waste motor oil to aquatic biota remains somewhat sparse. However, data now available does warrant our recommendation that no protective laws or regulations be enacted that would be unique to waste motor oil, but rather that waste oil be considered under more general guidelines which relate to oil pollution.

Past research which has been conducted at the National Marine Water Quality Laboratory with crude and refined oils, both in field and experimental conditions, has demonstrated the potential of petroleum to cause cancer in certain marine fauna. The vascular systems of some organims are also susceptible to petroleum products, including waste motor oil as herein presented. Obviously, these are potential hazards to the biological community which could cause considerable concern with the advent of widespread oil pollution.

Both these results and previous results have looked primarily at death and major morphological changes as the only response parameters of concern. There has been little work done on either sublethal effects or on community structure changes. This means that most of the toxicity values generated cannot be considered safe levels for the environment without further knowledge of these more sensitive effects.

INTRODUCTION

In response to the 1972 Water Bill, P.L. 92-500, a preliminary waste oil study report was sent to Congress in April 1973. A lack of knowledge about the biological effects of waste oils was evident at that time, although data were presented which related to the deleterious effects of other types of oil. Since the above mandate, studies have been completed on the biological effects of the most common type of waste oil, used crankcase oil, on various segments (phytoplankton, zooplankton, invertebrates and vertebrates) of the marine biota.

METHODS AND MATERIALS

PHYTOPLANKTON

Axenic cultures of the phytoplankton test species Skeletonema costatum and Thalassiosira pseudonana were maintained in enriched synthetic seawater, 30ppt, 20°C, and continuous cool white illumination to 2500 lux prior to experimentation. Stock cultures of these species were transferred every four days, for two weeks, prior to their use in bioassays. Two short-term bioassays were conducted, each having identical waste oil concentrations of 0.0, 0.5, 1.0 and 10.0 ppm. Each bioassay concentration was accomplished by aseptically transferring forty-nine ml of culture medium, containing 2.5 x 10^3 cells/ml, from a one liter glass dispenser into each of ten sterile, foam-plugged 125 ml Pyrex Erlenmeyer flasks, which served as test containers. One ml of a [illegible] sion was added to each test vessel, dependent on concentration, for a total volume of 50 ml. These cultures were incubated for four days. At twenty-four hour intervals, five ml of the oil-water emulsification was aseptically removed and the cell density was determined using an electronic particle counter. Growth rate was calculated from the following expression.

$$k = (\ln N_t - \ln N_0)/(t_2 - t_1)$$

where N_t = Cell density at time t_2

N_0 = Cell density at time t_1

ZOOPLANKTON

Cultured adult zooplankton, of the same age, were used for the waste oil bioassay at concentrations of 0.0, 10.0, 25.0, 50.0 ppm. Test species Acartia tonsa and Tigriopis japonicus, were reared in laboratory cultures at 20°C and 20ppt salinity, and under 1000 lux of cool white light on a 14:10 hour day-night cycle, prior to testing. These zooplankton were fed on a diet of three algal species, Rhodomonas baltica, Isochrysis galbana, and Thalassiosira pseudonana, prior to experimentation. Feeding was omitted during experimentation. Five adults, captured using a wide bore pipet, were transferred to borosilicate test dishes containing 100 ml of the above salt water medium. The salt water-waste oil emulsion was added following addition of test species. There were four replicate assays at each oil concentration. These animals were examined every twenty-four hours to monitor the death ratio. Experimentation is considered invalid if a mortality in excess of 15% is recorded in the control bioassay.

LARVAL FISH

Larvae of Menidia menidia were hatched from eggs spawned artificially in the laboratory. The eggs were incubated in artificial sea water at 20°C and 30ppt salinity. Test conditions, and waste oil concentrations were the same as for the zooplankton, except that only three exposure dishes per toxicant level were used.

MOLLUSCAN LARVAE

The adult oysters (Crassostrea virginica) and coot clam (Mulinia lateralis) were ripened for spawning at 20°C, and then induced to spawn by increasing the temperature to 27-28°C, One hundred freshly fertilized larvae obtained by the above method were placed in each of 22 test containers. Small, disposable plastic dishes, which served as test containers, contained 10 ml of artificial seawater having a salinity of 22ppt Waste oil was added at concentrations of 0.0, 1, 2, 3, 4, 5, 6, 7, 8, 9, or 10 ppm. The larvae were then cultured for 48 hours at 20°C and then examined for completeness of shell formation.

LARVAL LOBSTER

Lobsters (Homarus americanus), of the first larval stage, were exposed to waste motor oil concentrations of 0.0, 2.5, 5.0. 7.5, and 10.0 ppm. Due to the cannibalistic tendencies of lobster larvae, it is essential that each test organism be maintained in individual test containers. Therefore, ten individual lobster larvae at each oil concentration were placed in each of ten 70 x 50 mm Pyrex culture dishes. These dishes contained 100 ml of 32ppt salinity, filtered seawater which was maintained at room temperature (20-22°C). Following additon of the oil, the dishes were covered with watch glasses. The organisms were observed every 24 hours, for 96 hours, to record mortality. The lobster larvae require continuous feeding. Therefore, 1/10 ml of concentrated Artemia nauplii were fed to each larva every two days during the course of experimentation.

FISH

Acute and Sub-Acute

A total of approximately 400 adult Atlantic silversides (Menidia menidia), collected from Rhode Island estuaries, were utilized for the present study. The exposures were carried out at both acute and sub-acute levels of waste motor oil.

Adult Menidia were exposed to waste motor oil in their aquatic media. Acute exposures were conducted at initial concentrations of 0.0, 10.0, 50.0, 250.0, 1000.0 and 5000.0 ppm.

Sub-acute exposures were conducted at initial concentrations of 0.0, 20.0, 100.0, 250.0 and 500.0 ppm. Control organisms were maintained under prevailing environmental conditions of the experimental holding which was conducted at 20°C and 30ppt salinity. Test organisms were held at least 7 days prior to exposure.

Test aquaria for acute exposures consisted of glass jars which contained 2 liter of the above salt water. The sixty test organisms in this portion of the study were limited to five per test aquarium. Ten organisms were exposed at each concentration. These organisms were removed when moribund, dead, or after 96 hours. Test aquaria for sub-acute exposures consisted of circular, fiberglass tanks having a total capacity of 650 liters. These aquaria contained 500 l of the above saltwater. Fifty to 75 test organisms were added to each aquarium for testing purposes. The waste oil was added as an emulsion to the test media following the introduction of the fishes. The aquatic media and the oil concentration were renewed on a weekly basis in the sub-acute portion of the study.

Sufficient aeration was administered in the acute exposure study to maintain adequate dissolved oxygen levels (6-8 mg/l). Initially, aeration was not administered in the sub-acute study. However, high mortality at the two highest oil concentrations dictated aeration, which was accomplished by the use of one air-stone to maintain a satisfactory DO level. Fishes in the sub-acute test were fed a commercial fish food preparation on a daily basis. Sub-acute exposures to 20 mg/l of emulsified waste oil were maintained for 60 days, to 100 mg/l for 36 days and a 250 mg/l for one week.

ADULT OYSTERS AND SCALLOPS

Adult Amercian oysters (Crassostrea virginica) and bay scallops (Acquipectin irradians) were simultaneously exposed to the same sub-acute waste oil concentrations as were the adult Menidia. Approximately 20-25 oysters and 12 scallops were exposed at each concentration (0.0, 20.0, 100.0 and 500.0 ppm).

Adult Atlantic silversides, oysters and scallops were prepared for histological processing when they were observed to be in a moribund state, or at termination of the experiment. Atlantic silversides were immediately immersed in Dietrich's fixative, while oysters and scallops were shucked and placed in Zenker-Formal fixative. Following fixation, selected tissues underwent routine histological processing. Tissue sections, cut at 6u, were stained with Harris Hematoxylin and Eosin (H&E).

All oil concentrations are based on a volume-to-volume ratio and are expressed as parts-per-million (ppm). A concentration of one ppm thus refers to a concentration of 1 ml waste oil per 1000 l seawater. Unless otherwise specified, waste oil emulsions were obtained by homogenizing waste oil and salt water with a laboratory blender for approximately two minutes. The physical and chemical characteristics of the waste oil used in this study is provided in Table 1, Appendix C, The Effects of Waste Oil and Freshwater Aquatic Life.

RESULTS AND DISCUSSION

Waste oil concentrations acutely lethal to 50% of the larval coot clam, oyster, and lobster ranged between 1 and 5 ppm (Table 1). These larval fauna were the most sensitive of the organisms tested. Phytoplankton, zooplankton and larval fish were more resistant to the waste oil, since waste oil concentrations of from 10 ppm to greater than 50 ppm were required to achieve the same results. In terms of acute toxicity, the adult Atlantic silversides were the most resistant.

TABLE 1

ACUTE TOXICITY OF EMULSIFIED WASTE OIL

Species	LC-50*	Time, hr.
Coot Clam (Larval)	1-2	48
Oyster (Larval)	4-5	48
Lobster (Larval)	5	96
Phytoplankton		
S. costatum	>10	96
T. pseudonana	>10	96
Zooplankton		
A. tonsa	15	96
T. japonicus	> 50	96
Fish		
Menidia (Larval)	>25	72
Menidia (Adult)	1700	96

*Concentration required to kill 50% of the species in the stated time

PHYTOPLANKTON

Waste oil concentrations from 0.5 to 10.0 ppm had little apparent effect on the growth of either of the test species. During the first twenty-four hours of exposure the growth rate of *Skeletonema costatum* was depressed by 40% at 1.0 ppm to 10.0 ppm. However, only at 10 ppm did the inhibition persist after twenty-four hours. Duplication of the experiment in a different synthetic seawater resulted in less than 10% inhibition at 10 ppm after ninety-six hours. Likewise, similar experiments using *Thalassiosira pseudonana* failed to produce significant inhibition of growth.

Although the above results indicate that emulsified waste oil has a low hazard potential, further experimentation with unemulsified oil may produce quite different results. Such experiments should be included in further testing, because crude oils added directly to seawater at concentrations ranging from 2 to 10 ppm have had a marked lytic effect on phytoplankton. Further, #2 fuel oil is markedly toxic to phytoplankton at 0.25 ppm (Gentile, unplublished).

ZOOPLANKTON

The concentration of emulsified waste oil acutely lethal to 50% (LC-50) of *A. tonsa* after 96 hours was 15 ppm, while the LC-50 for *T. japonicus* was greater than 50 ppm.

The two species of copepods demonstrated an anticipated sensitivity, since *A. tonsa*, which is a free-swimming oceanic form, has in the past demonstrated a high degree of susceptibility to a variety of pollutants. *Tigriopis japonicus*, on the other hand, is an estuarine species that is a bottom dwelling organism which inhabits lower salinity saltwater, and has demonstrated a much higher resistance to pollutants in general.

Unlike the other species in the present report, *A. tonsa* was utilized to determine the toxicity of the waste oil as applied directly to the salt water medium (layered) and the salt water soluble extract of waste oil.

Seven experimental concentrations of waste oil (0.0, 50, 100, 250, 500, 750, and 1000 ppm) were used. The toxicity of waste motor oil as applied by these methods was not significantly different than that of emulsified waste oil. The 96-hr LC-50 for layered waste oil was 15 ppm while the 96-hr LC-50 for the salt water soluble extract was 35-40 ppm.

LARVAL FISH

The lethal concentration of emulsified waste oil required to kill 50% of the larval stage of *M. menidia* in a 72-hour exposure period was greater than 25 ppm (Table 1).

MULLUSCAN LARVAE

Acute toxicity values of emulsified waste oil were not determined for oyster and coot clam larvae. Rather, the development of shell growth served as an index of toxicity to these organisms. The toxicity of oils and oil dispersants has previously been investigated by these methods (Tarzwell, 1969), and they have proven to be a sensitive indication of relative toxicity. Emulsified oil concentrations of 1 ppm or higher retarded the normal shell growth of the coot clam, while a concentration of 4 ppm or higher caused similar retardation of oyster larval shell growth. Deformation of the shells also occurred at these concentrations.

LOBSTER LARVAE

The lethal concentration required to kill 50% of stage one larval lobsters was 5 ppm. This value compares very closely with previous tests with Venezuelan crude by Wells (1972).

FISH

Petroleum products are known to be carcinogenic to some marine invertebrates, (Blumer, 1971; Barry, 1971; Barry, 1972), and the lethal effects of an oil spill can continue to affect an invertebrate community for periods of up to a year or more (Blumer, 1971). The known effects of petroleum on pelagic, benthic and estuarine fishes, however, remain relatively sparse. Recent investigations have indicated that sensory coordination may be impaired in some fishes. Precancerous lesions in the olfactory organs have been documented in the estuarine teleost Menidia menidia (Atlantic silversides) following an experimental exposure to the salt water soluble fraction of Texas-Louisianna crude oil (Gardner, 1972). Menidia has demonstrated prior sensitivity to a petroleum derivative and, therefore, was selected as a representative estuarine teleost to evaluate the potential effects of waste motor oil.

Acute

The lethal concentration of the waste motor oil required to kill 50% of the adult Menidia exposed to 10, 50, 250. 500, 1000 and 5000 ppm was established at 2250 ppm for 48 hours and 1700 ppm for 96 hours. These values were not determined for the sub-acute exposures.

Sub-acute

Histologically, an irregularity in the pigmentation, or staining capacity of connective tissue which accompanies the dorsal aorta occurred as a rather consistent finding regardless of the waste oil concentration. The connective tissue in these cases appeared "olivelike", or golden-brown in color following an H&E stain. The irregularity was variable, in a case-by-case comparison, in terms of the density of coloration or pigmentation.

Muscle bundles and muscular valves in the auricle of the heart were affected. The change associated with these structures again involved pigmentation. Clusters of dark-pigmented spherules aligned the periphery of the muscular structure throughout the auricle. The spherules, ranging from approximately 0.5u to 4u, were also incorporated into the nuclear and cytoplasmic morphology of the musculature of the auricle and its valves. In severe cases, the morphology of the musculature was masked by the presence of numerous spherules. The condition was evident following exposures to 20 ppm of waste oil and at all higher concentrations. The ventricle of the heart was affected in a similar pattern in one case, in an organism exposed to 100 ppm of waste oil.

The pseudobranch was affected in specimens which reached the maximum exposure period of 36 days at the 100 ppm level. The secretory cells of the organ were necrotic, while the vasculature remained intact. The condition is not unlike that in Menidia following exposure to the salt water soluble fraction of crude oil as described by Gardner (1972).

The significance of the irregularities associated with the dorsal aorta and the auricle of the heart cannot be determined at the present time. Likewise, the significance of lesions associated with the ventricle of the heart and the pseudobranch cannot be determined at present. However, the pseudobranch, a specialized pressure and chemoreceptor, is very sensitive to Po_2 and Pco_2 in arterialized blood. Plausibly, alterations which were observed throughout the major arterial system of Menidia may relate to an alteration of the extensive nerve plexus which accompanies the pseudobranch.

ADULT MOLLUSCS

Relative toxicity values for adult oysters and scallops to sub-acute exposures of emulsified waste motor oil (Table 2) were estimated following termination of enpermentation. The scallop proved to be more sensitive to the waste oil than was the oyster. These toxicity findings are comparable with prior research results that indicate the scallop to be much more susceptible to pollutant exposures than is the oyster.

TABLE 2

RELATIVE TOXICITY OF EMULSIFIED WASTE OIL TO:

a) Scallop

Oil Concentration, ppm	% Mortality	Time
500	100	6 hours
100	100	24 hours
20	100	20 days
0 (control)	40	60 days

b) Oyster

Oil Concentration, ppm	% Mortality	Time
500	80	2 days
100	50	36 days
20	20	60 days
0 (control)	20	60 days

Oysters

Macroscopic - Visual examination of oysters necrospied at the termination of experimentation revealed numerous, small black foci throughout their mantle. The condition was most common in the animals surviving 100 ppm of the waste oil, since 65% of these oysters displayed the condition, while only 15% surviving the 20 ppm test concentration displayed the condition. These black foci were not evident in control specimens.

Microscopic - The gastro-intestinal tract of the five oysters surviving the 500 ppm test concentration had a detached mucosa, while extensive vacuolation occurred within the mucosa proper.

Involvement of the vascular system was apparent in three of four oysters sampled for the 100 ppm level after six days exposure. The efferent vein and its branches into the gill arches were occluded with clots as indicated by the presence of "acute and chronic" amebocytes and fibroblasts ("acute and chronic" relates to the morphological state of these cellular constituents as observed in response to an inflammatory condition). The occulusions primarly contained "acute and chronic" amebocytes. Many amebocytes had attached to the vascular wall of the gill. The hearts of two oysters had amebocyte accumulations, wherein attachment to the cardiac muscles had also occurred. Fibroblast accumulations in the heart were observed in only one case. Two oysters, of the four sampled, had black, granular material dispersed throughout the gill filament structure.

Five of the nine oysters surviving 60 days exposure to 100 ppm of waste oil had lesions which involved the cardio-vascular system. Eight of these oysters had spherical, yellowish-brown granules, refractile and variable in size, located in the gill filaments, mantle and visceral organs. These granules were also concentrated in the food groove associated with the gill. The lumen of the gastro-intestinal tract was outlined by these granules in four of the nine oysters examined. The granule deposition was heaviest in the basement membrane of the mucosa, while a limited presence was observed in the epithelial cells of the mucosa. The mantle and its ligament in five of nine animals examined was also outlined by the presence of these granules, while other cells were in a state of degeneration. Detachment and vacuolation of the mucosa, as observed in oysters exposed to 500 ppm oil, was also present in eight out of nine oysters exposed to 100 ppm.

Eighteen oysters were necropsied at the termination of the 20 ppm exposure level, of which, nine had cardio-vascular involvement such as that previously mentioned. Substantial areas of the mantle of three animals possessed the previously mentioned deposition of black granular material.

Three of the eighteen control oysters had an "acute" amebocyte accumulation in the vascular system. However, no "chronic" amebocytes or fibroblasts were noted in these accumulations. Neither the vascular walls, nor any other areas affected by the used oil, were involved.

Scallops

Scallops exposed to 500 ppm oil had several acute responses. The gill filaments were necrotic as indicated by loss of the ciliated columnar epithelium. In addition, the plicate membranes of the gills were dilated due to congestion by amebocytes. Fine, black granular material was deposited between and within the gill filaments. Gills of scallops exposed to 100 ppm waste oil were devoid of cilia, which are associated with the ciliated columnar cells of the gill filament. The kidneys had an amebocytic infiltration (inflammatory response) along the kidney folds. Necrosis and sloughing of the renal epithelium had also occurred. No lesions were observed in those scallops exposed to the 20 ppm of waste oil that could be attributed to the action of the emulsion.

Cystic formations, which contained cellular debris and amebocytes, were observed in the kidney of control scallops. However, the condition does not compare with that observed following oil exposure.

Lesions in the kidney of the scallop and in the cardio-vascular system of the oyster are important. Although very little is presently known about the etiology of the cardio-vascular lesion in the oyster, it is consistently found in oysters which have been exposed to oil in both laboratory and field situations. Previous studies with oysters have demonstrated amebocytic infiltation of the gastro-intestinal tract, which indicates that the gastro-intestinal system serves as an excretory site for the amebocytes.

The meaning of the refractile, yellowish brown, round granules also remains unknown. Possibly they represent a form of excretory product, for the greatest concentrations of them continue to be found in tissues which are excretory in function. Finally, it might be indicated, based on past experience at the National Marine Water Quality Laboratory that the vascular system of the oyster is highly susceptible to crude oil and distillates of crude oil. However, many other invertebrate fauna, which were not studied for the current report, are known to be susceptible to cancer. These observations have been documented following exposures to accidental oil spills which have occurred in the environment.

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APPENDIX E

FEDERAL TAX TREATMENT OF THE RE-REFINING INDUSTRY

TAX CODE TREATMENT OF RE-REFINERS, 1932-1964

The tax on lubricating oil dates to 1932, when a 4¢ a gallon tax was levied as part of a broad effort to increase federal revenue during the depression. The proceeds from the tax were treated as general revenue, and were not earmarked for special use. In the revenue bill passed by the House, (1) the only lubricating oils to be taxed were those of viscosities suitable for use in internal combustion engines. However, the Senate voted to eliminate the viscosity limitations of the House bill, noting that the tax could be evaded by mixing tax-free light and heavy oils. (2) The enacted Revenue Act of 1932 (3) reflected this Senate concern and imposed a tax of 4¢ per gallon to be paid by manufacturers or producers on all grades of lubricating oil.

The tax rate was raised an additional one half cent in 1940 (4) and one and one half cents in 1942 (5) to produce revenue to finance the war effort.

The applicability of the tax to the lubricating oil products of the re-refining industry was the subject of a controversy spanning twenty-four years focused on the question of whether the re-refiners were to be treated as "manufacturers" under Internal Revenue regulations. Since only "manufacturers" were subject to the excise tax, resolution of this definitional question was of considerable interest to both the re-refiners and their competitors.

In the Revenue Act of 1932, no definition of "manufacturer" was provided, nor was there explicit exclusion of re-refined products from tax. Twelve days after the Act's enactment, the first Internal Revenue regulations describing its scope were promulgated, but still no effort was made to define the term "manufacturer." (6) One month later, however, the regulations were amended, and included within the definition of "manufacturer" or "producer" were all reprocessors of used lubricating oil. (7) The revised regulations were amended by a Treasury Decision nine months later, in March 1933, which limited the definition of "manufacturer" or "producer" to re-refiners using one specified process which produced oil with substantially the same physical and chemical characteristics of new lubricating oil. (8) The regulations were amended yet again, in September 1934, to provide that

> any person who cleans, renovates or refines used or waste lubricating oil by any method or processing which produces an oil substantially equivalent to new lubricating oil

would be considered a "producer" or "manufacturer." (9) (emphasis added)

The Bureau of Internal Revenue seemed uncertain how to apply its constantly changing regulations. For example, in late 1933, the reprocessed products of Super Refined Oil Company were being exempted from the tax, while the reprocessed products of Triplex Oil Refining Company and Keystone Oil Company were being taxed. (10) However, in early 1934, Triplex received a ruling that its re-refining process did not constitute it as a manufacturer or producer under the law, and in late 1934, Keystone received a refund for the taxes it had paid.(11)

By 1938, IRS was reconsidering the wisdom of attempting to tax reprocessed oil under its regulations. From the end of 1938 until late 1954, favorable rulings were given all re-refiners who applied for tax exemptions. (12) Though re-refiners were thus made exempt from paying excise tax on their end products, they had to pay tax on the virgin oil which they mixed with their reprocessed oil to upgrade it. Had they been officially treated as "manufacturers", they would have had to pay an excise tax on their end products, but they would have been able to purchase virgin oil free of tax for use in blending, for the IRS regulations stipulated that no tax would be imposed upon any material used in the manufacture or production of a taxable article. (13) A Treasury Department official familiar with the history of reprocessed oil taxation contends that the Internal Revenue Bureau declined to tax the re-refiners because it had difficulty proving that the re-refiners' product was equivalent to virgin lubricating oil. (14) The re-refiners reply, however, that the quality question was immaterial, and, that the Bureau actually declined to tax them because it knew a tax could not withstand court challenge. The re-refiners contended that their products should be tax exempt not because they were alleged to be qualitatively inferior, but because Congress did not intend for the re-refining industry to be taxed at all. (15)

The administrative decision to forego taxing the re-refiners stimulated a series of legislative proposals to tax the re-refining industry. Between 1939 and 1949, seven such bills were introduced by four members of the House Ways and Means Committee and the Senate Finance Committee, but none were reported from Committee. (16)

In late 1950, Donald O'Hara, the Assistant General Counsel of the National Petroleum Association, called to the Internal Revenue Bureau's attention the fact that a re-refiner in an FTC proceeding had contended that the quality of his lubricating oil matched that of most premium motor oils. (17) O'Hara's implication was that the re-refiner should be taxed. The Bureau responded by noting that three unsuccessful attempts had been made to legislate an excise tax on reclaimed and re-refined oil and that it was not going to alter its position. (18)

In August 1954, O'Hara filed suit on behalf of Barkow Petroleum Company against the Commissioner of Internal Revenue. The suit sought a mandatory injunction requiring IRS to collect excise tax on reprocessed oils represented and sold as equivalent to new lubricating oils. (19)

O'Hara requested dismissal of the suit when he received a letter from the Commissioner of Internal Revenue stating that the IRS would re-examine its position on reprocessed oil and that it would, if necessary, test the issue in the courts. (20) The IRS notified the Association of Petroleum Re-refiners in March 1955 that it was going to attempt to tax reprocessed oil and that the re-refiners were welcome to test the action judicially. But after meeting with the re-refiners to discuss its proposed new policy, IRS abandoned it. Instead, in T. D. 6197, the Service changed its definition of the term "manufacturer" to give recognition to the de facto taxation situation that had existed since 1938. Its new definition provided that

> The term "manufacturer" does not include (1) a person who merely blends or mixes two or more taxable lubricating oils, (2) a person who merely cleans, renovates, or refines used or waste lubricating oil, or (3) a person who merely blends or mixes one or more taxable lubricating oils with used or waste lubricating oil which has been cleaned, renovated, or refined. (21)

Those re-refiners falling within class (2) were those who had been legally subject to the excise tax on their end product, but who had never paid such a tax because the quality equivalence of their end product with virgin oil was not proved. Re-refiners in category (3) were those who continued to produce non-taxable products on whose virgin oil component an excise tax had been paid.

The struggle over the revenue regulations had been intense because they provided a competitive advantage in the lubricating oil market to the re-refiners. For those of their products made exclusively of reprocessed oil, the re-refiners were able to avoid the 6¢ a gallon tax paid by their competitors, the virgin oil marketers. For those products comprised of both virgin and reprocessed oil, if a 50-50 mix of oils is assumed the re-refiners were given a 3¢ a gallon competitive edge, for they only had to pay excise tax on that portion of their product that was comprised of virgin oil. The re-refiners maintain that because their profit margin was so small, it was only through maintenance of the tax distinction between their product and virgin lubricating oil that they were able to continue operating. (22)

THE EXCISE TAX REDUCTION ACT OF 1965

In 1964, Congress and the administration began to weigh gradual elimination of many excise taxes which had developed over the years and which were widely viewed as imposing excessive burdens on the marketplace. As part of its tax reduction program, the administration suggested complete elimination of the excise tax on lubricating oil. (23)

At hearings on the administration proposal before the House Ways and Means Committee, two speakers addressed their remarks to the proposed reduction in the lubricating oil excise tax. Rudolph Cubicciotti, representing the American Petroleum Institute and Pennsylvania Crude Oil Association, organizations comprised of the major virgin oil marketers, supported elimination of the tax. (24) Noting that lubricating oils used for non-lubricating purposes were tax-exempt, he argued that the excise tax represented a tax on use of a commodity, rather than on the commodity per se. He observed that the tax also presented an administrative burden, for certificates of tax exemption had to be maintained and processed. Furthermore, he contended that the excise tax had developed in the course of revenue emergencies which were no longer of any concern. Since the tax served no non-revenue social policy goals, he argued, it should be removed. Cubicciotti also observed that the tax was an especial burden for farmers and motorists.

The second individual speaking on the lubricating oil tax question was a representative of the Association of Petroleum Re-refiners. (25) V. T. Worthington, Executive Director of the Association, contended that the re-refining industry would be hard hit by elimination of the excise tax. He observed that the price level of re-refined products was determined in large measure by the price set for virgin lubricating products, and that the re-refiners' profit margin was so small that elimination of the 6¢ per gallon competitive edge provided by the excise tax would drive many re-refiners out of business. Worthington conceded that the reasons given for eliminating the excise tax were forceful, but for equally compelling reasons, he suggested, it should be retained. The industry, he said, performed a public service by providing an alternative to the mere dumping of waste oil into the environment, an alternative that promoted resource conservation and elimination of waste oil as an environmental pollutant. Worthington concluded that the excise tax status quo should be maintained, with the tax accepted as creating, in effect, a payment for the services of the industry. He noted in this context that the virgin oil producers were themselves recipients of a government subsidy, in the form of a 27.5 percent depletion allowance.

The House Ways and Means Committee developed a statute which it believed would eliminate much of the excise tax without unduly harming the re-refiners. Section 202 of the House bill maintained the 6¢ per gallon tax on lubricating oil (26) and Section 210(a) and (b) of the bill earmarked the tax proceeds for the Highway Trust Fund. (27) However, Section 202 also provided for a rebate of the tax paid, when the tax was paid on lubricating oil purchased for non-highway use. The rebate provision was to be made Section 6424(a) of the Internal Revenue Code and was to read as follows:

> If lubricating oil (other than cutting oils, as defined in Section 4092(b), and other than oil which has previously been used) is used otherwise than in a highway motor vehicle, the Secretary or his delegate shall pay (without interest) to the ultimate purchaser of such lubricating oil an amount equal to 6 cents for each gallon of lubricating oil so used. (28)

The Ways and Means Committee expressed concern for the economic health of the re-refining industry in its report on the excise tax reduction measure:

> Your committee concluded that generally the lubricating oil tax was an undesirable tax to continue. However, it was recognized that to the extent that lubricating oil is used in highway motor vehicles, the tax represents an appropriate charge on the users of highways similar to the gasoline and tire taxes are presently assigned to the Highway Trust Fund. Your committee also recognized that the outright repeal of this tax might also present problems for the re-refiners of oil, who are not subject to the lubricating oil tax and whose profit margin generally is smaller than the amount of this tax. Therefore, to repeal this tax outright in many cases would drive re-refiners out of business. This would have the effect of encouraging the dumping of used oil in our streams rather than salvaging it through re-refining.
>
> Your committee's bill for the reasons indicated above in effect removes the tax on all lubricating oils except those used in highway vehicles. (29)

The Senate Finance Committee believed that the House measure did not provide adequate protection for the re-refining industry. Accordingly, it sought to maintain the excise tax on lubricating oil by striking the House bill's lubricating oil provisions. The Senate report commented:

> The House recognized that the outright repeal of this tax might present problems for the re-refiners of oil who presently are not subject to the lubricating oil tax and whose profit margin generally is smaller than the amount of this tax. The House recognized that to repeal this tax outright would drive many re-refiners out of business and it was noted that this would have the effect of encouraging the dumping of used oils in our streams rather than salvaging it through re-refining.

> It was pointed out to your committee that much the same type of problem exists in the case of non-highway use....Thus, retaining the tax on lubricating oils for highway purposes alone does not completely remove the competitive problem of the re-refining industry nor remove the encouragement to dump used oil. It was for these reasons that your committee fully restored the present tax in the case of ... lubricating oils. Since much of this tax, as reconstituted by your committee, is not basically a highway use revenue, your committee also removed the provision in the House bill which would have allocated this revenue share for the Highway Trust Fund. As compared to present law, the changes made by your committee with respect to lubricating oil will have no effect. (30)

The tax reduction measure ultimately signed into law contained the House lubricating oil tax provisions, the Senate's serious reservations notwithstanding. The law's legislative history reveals that retention of the provisions was solely the consequence of a "log-rolling" conference committee compromise. The Senate conferees withdrew their objections to the House lubricating oil tax provisions in exchange for the House conferees' withdrawal of objections to a Senate provision providing income tax credit to farmers for taxes paid on gasoline used for farm or other non-highway uses. (31)

POST-1965 INCOME TAX REGULATIONS AND REVENUE RULINGS

The Excise Tax Reduction Act (ETRA) caused the re-refiners to lose their 6¢ per gallon competitive advantage in the non-highway lubricating oil market. Its effects can be demonstrated in the following example:

Suppose that to a non-highway user the net cost of both virgin oil and a 50-50 blend of virgin and reprocessed oil is $1.20. Prior to ETRA, the user would have had to pay an additional 6¢ on the virgin oil product and an additional 3¢ tax on the blended product. Other things being equal, the non-highway user would have preferred to purchase the relatively cheaper reprocessed product. Following ETRA, the non-highway user was eligible for a rebate on the tax paid on virgin lubricating oil. Thus, the purchase price of the 100% virgin lubricating oil was reduced to its net cost of $1.20. Theoretically, the purhcase price of the mixed product would also have been $1.20, if the tax was refunded on its virgin oil component. With the two products at parity, it was unlikely that a non-highway user would be inclined to purchase a "used" product when a "new" product could be had at no additional expense.

In theory, then, the re-refiner was likely to suffer somewhat from ETRA, the good intentions of the House and Senate notwithstanding. In practice, the re-refiner was to suffer even more, for under IRS revenue ruling 68-108, the re-refiner and his off-highway customer were declared ineligible for rebate of the tax on the virgin oil component of blended products. The re-refiner was thus placed at a 3¢ per gallon competitive disadvantage vis-a-vis the virgin oil marketer.

In reaching the 68-108 decision, IRS argued that even though a re-refiner had "used" the virgin oil in his blending process, he had not "used" it "otherwise than in a highway motor vehicle" within the meaning of Section 6424 of the Internal Revenue Code and thus he was not entitled to a rebate. IRS maintained that the type of "use" contemplated with Section 6424 was

> use of lubricating oil (previously unused) through which use the oil is consumed or rendered unfit for further use as a lubricant. In the case of blending by the re-refiner, the "new" oil is not consumed in the blending process but becomes a part of the non-taxable resultant product which the company sells to consumers who use it in non-highway vehicles. (32)

Furthermore, the non-highway user purchasing a blend of virgin and reprocessed oil was not entitled to a rebate; for he was not using "new" (previously unused) lubricating oil within the meaning of the ETRA rebate provision, but was using the re-refiners' nontaxable product in the blending of which the virgin oil had become "used."

IRS's conclusions in 68-108 are quite questionable. First, as the statute presently reads, it is the clear intent of Congress that the lubricating oil tax in effect becomes a special fee paid by highway users to promote highway building. While one might argue that the re-refiners have an indirect interest in seeing highways built, so that more automotive lubricating oil is consumed in their use, one is hard-pressed to find any other logical nexus between the re-refiners' blending activity and highway use. Second, it could scarcely have been the intent of Congress to have railroad purchasers of blended reprocessed oil pay a tax that underwrites a highway construction subsidy for the railroads' competitors, the trucking industry. (33)

Reversal of Revenue Ruling 68-018 is suggested because, on its face, it places the re-refiners at a disadvantage in the non-highway lubricating oil market. It permits rebate of excise taxes on virgin oil products without permitting a rebate of taxes on reprocessed products, it appears to run contrary to congressional intent, and it produces an anomolous situation in which railroads may pay subsidies to their highway competitors.

Reconsideration of Revenue Ruling 68-108 by the Internal Revenue Service would be consonant with the requirements of the National Environmental Policy Act. (34) Section 101(b)(6) of the law declares that the Federal Government should improve its plans and programs to "enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources." Section 103 requires federal agencies to review their policies and procedures as a first step in bringing them into conformance with the national environmental policy embodied in Section 101.

(1) See H. Rpt. 72-708 (March 8, 1932) at 35.

(2) See S. Rpt. 72-665 (May 9, 1932) at 43.

(3) Public Law 72-154. Section 601. Excise Tax on Certain Articles

* * *

> (c) There is hereby imposed upon the following articles sold in the United States by the manufacturer or producer...a tax at the rates hereinafter set forth, to be paid by the manufacturer, (or) producer...: (1) Lubricating oils, 4 cents a gallon;

(4) Revenue Act of 1940, 1650.

(5) Revenue Act of 1942, 608.

(6) Regulations 44 Relating to the Taxes on Lubricating Oil...under the Revenue Act of 1932 (1932 ed.) at 8.

(7) T. D. 4339, XI-2, C. B 446 (1932.

(8) T. D. 4362, XII-1, C. B. 380 (1933).

(9) Regulations 44 (1934 ed.) at 33; 314.40, Internal Revenue Code of 1939.

(10) Example, cited in "Memorandum: Excise Tax on Lubricating Oil," (Arlington: Virginia: Association of Petroleum Re-refiners, 1955) at 2.

(11) Id.

(12) Id.

(13) 620, Revenue Act of 1932.

(14) In a report to a Council on Environmental Quality Task Force on Waste Oil, John Copeland of Treasury's Office of Tax Analysis wrote:

"...Legend has it, the Bureau of Standards would not testify that reclaimed oil was the equivalent of or substantially equivalent to new oil."

"Waste Oil Study," (May 25, 1970, 7pp. mimeographed) at 1.

(15) Interview with V. T. Worthington, Executive Director of Association of Petroleum Re-refiners, October 23, 1973.

(16) H. R. 5133 introduced into the 76th Congress on March 20, 1939, by Rep. Disney; H. R. 6498 introduced into the 76th Congress on May 24, 1939, by Rep. Disney; H. R. 3071 introduced into the 77th

Congress on February 4, 1941 by Rep. Disney; Amendment to H. R. 7378 introduced into the 77th Congress on August 3, 1942 by Sen. Guffey; H. R. 5386 introduced into the 81st Congress on June 9, 1949 by Rep. Gavin; S. 2172 introduced into the 81st Congress on June 30, 1949 by Sen. Martin; H. R. 5448 introduced into the 81st Congress on July 14, 1949 by Rep. Gavin.

(17) Reported in National Petroleum News, June 18, 1952, 44:25 at 33.

(18) Reported in National Petroleum News, July 22, 1953, 45:22 at 33. The reference to three attempts probably refers to the seven bills introduced into three Congresses. See note 16 supra.

(19) Barkow Petroleum Company v. T. Coleman Andrews, Commissioner of Internal Revenue (D. D.C.).

(20) Petition for dismissal filed October 21, 1954 following receipt of letter from Commissioner Andrews dated October 15, 1954.

(21) T. D. 6197, Cum. Bull, 56-2,803 (1956).

(22) See text accompanying notes 25 and 29.

(23) See 202 of the administration proposal in "Legislative History of H. R. 8371, 89th Congress, the Excise Tax Reduction Act of 1965,

Public Law 89-44, "House Committee on Ways and Means, 89th Congress, 1st Session at 62 (Hereinafter cited as ETRA Legislative History).

(24) See "Hearings on the Federal Excise Tax Structure before the Committee on Ways and Means, U. S. House of Representatives, 88th Congress, 2nd Session, July-August, 1964 at 620-627 (Hereinafter cited as ETRA Hearings).

(25) Id. at 686-690.

(26) See ETRA Legilsative History, supra note 23 at 161, 195.

(27) Id. at 177.

(28) Id. at 162.

(29) Id. at 231.

(30) Id. at 534.

(31) Id. at 811, 815. The Senate had with its amendment #7, deleted the lubricating oil provisions of the House bill. With its amendment #101, it added the gasoline tax rebate for farmers. The House agreed to the Senate addition of amendment #101, and in exchange, the Senate withdrew amendment #7 that had deleted the lubricating oil

provisions. The "Statement of the Managers on the Part of the House" explains the trade as follows:

Amendment No. 7: The bill as passed by the House continued the 6-cent-a-gallon excise tax on lubricating oil, but provided for refunds to ultimate purchasers of taxes paid with respect to such oil used for nonhighway purposes. It also allocated the tax attributable to lubricating oil used for highway purposes to the highway trust fund...

The Senate amendment deleted these provisions of the house bill.

The House recedes with amendments conforming to the action on amendment No. 101...

Amendment No. 101: Under present law, farmers and other non-highway users may obtain refunds of taxes used for farm and other off-highway purposes. Credits for such taxes are not provided. The bill as passed by the House made no change in this refund procedures. Senate Amendment No. 101 provides that the tax on gasoline used for farm use or other nonhighway purposes may be credited against the farmer's or other user's income tax liability. Under the amendment, if the exercise tax on such gasoline exceeded the user's income tax liability the excess would be refunded to the user.

The House recedes with an amendment which provides the same procedure for lubricating oil used for nonhighway purposes.

(32) Rev. Ruling 68-108, Cum. Bull. 68-1, 561.

(33) This argument was made in a May 18, 1966 letter from the Re-refiner's attorney to Mr. Bernard Fischgrund, Chief of IRS' Excise Tax Branch.

(34) Pub. L. 91-190, 42 U.S.C. 4321 et seq.

APPENDIX F

GOVERNMENT ACTION GOVERNING OIL CONTAINER LABELING

State laws and federal regulations provide that labels on containers of reprocessed oil must disclose that the containers' contents have been reprocessed from previously used lubricating oils. The discussion below surveys the mix of state and federal requirements for reprocessed oil labeling, and evaluates proposals made for their reform.

STATE LABELING LAWS

State labeling laws governing reprocessed oil can be divided into two categories:

(1) Statutes specifying that purchasers of lubricating oil and other petroleum products shall not be deceived as to the nature, quality or identity of their petroleum product purchases,

(2) Statutes stating that reprocessed lubricating oil must be labeled so as to disclose its previous use.

General Deception Statutes

Seventeen states presently have general petroleum product misbranding statutes. 1/ As column 1 of Table 1 shows, most were enacted in the 1920's and 1930's. The provisions are fairly uniform and the Florida statute is typical:

> No person shall store, sell, offer, or expose for sale any liquid fuels, lubricating oils, greases, or other similar products in any manner whatsoever which may deceive or tend to deceive, or which has the effect of deceiving, the purchaser or said products as to the nature, quality, or quantity of the products so sold, exposed, or offered for sale. 2/

Such statutes arguably forbid sale of reprocessed oils not labeled as such; absent disclosure, purchasers of such products

Table 1. CHRONOLOGY OF GENERAL AND SPECIFIC STATE OIL LABELING LEGISLATION

Period	General laws enacted	Specific laws enacted[a]
1925-1929	5	-
1930-1934	6	-
1935-1939	3	1
1940-1944	-	2
1945-1949	0	3
1950-1954	2	6
1955-1959	1	2
1960-1964	-	1
1965-1969	-	-
Date uncertain	-	5

[a] In instances where states have amended their specific labeling laws to incorporate new requirements, only the earliest enactments are included in the above chart.

would likely mistake them for virgin lubricating oil. 3/

Disclosure Provisions Specific to Reprocessed Oil

Disclosure provisions specific to reprocessed oil are found in the laws of twenty states; 4/ in seven states they supplement the general misbranding provisions described above while in thirteen others they stand alone. 5/

Column 2 of Table 1 traces the chronology of state labeling statutes specific to reprocessed oil. Most were enacted in the 1950's, at about the same time that the Federal Trade Commission was initiating much of its reprocessed oil regulatory action.

The state statutes are quite diverse. Table 2 (and its explanatory footnotes) summarizes their provisions. Sixteen states specify the language and lettering in which previous use disclosure must be made. Three states require previous use disclosure on containers' front panels. These latter state laws were enacted after promulgation of an FTC trade regulation ruling requiring frontpanel disclosure on all reprocessed oil sold in interstate commerce. 6/

State Labeling Laws: Legal Challenges

State labeling laws have twice been challenged by oil reprocessors and have been upheld on both occasions.

In Paraco, Inc. et al v. Department of Agriculture, 7/ an oil rerefiner challenged the application of California's reclaimed oil labeling requirements 8/ to its product. In its complaint, Paraco argued that the California law was unconstitutional, because it was vague, uncertain and deprived the company of equal protection under law. 9/ Paraco contended that because in the public mind "reclaimed" was synonomous with "inferior," the labeling requirement would unfairly demean its rerefined product that was equivalent or superior in quality to virgin lubricating oils. 10/ Paraco maintained also that the labeling law, by adversely affecting its sales, "would result in the waste of a valuable asset and prevent

Table 2. PROVISIONS OF STATE REPROCESSED OIL LABELING LAWS

State	A	B	C	D	E	F	G
Alabama		x		x			
California		x	x	x	x	x	x
Colorado		x					
Connecticut	x						
Florida			x	x			
Georgia		x		x			
Idaho		x					x
Illinois		x		x			
Indiana		x		x			
Louisiana		x		x			
Maryland	x						
Massachusetts		x					
Mississippi		x	x				
Missouri		x					
New Mexico		x			x	x	x
New York	x						
Nevada		x					
North Carolina		x				x	
Texas		x					
Wisconsin		x		x			

Code:

A Previous use disclosure required on containers. Specific words and letters not indicated.

B Previous use disclosure required on containers. Specific words and letters indicated.

C Previous use disclosure required on front panel containers.

D Previous use disclosure required in advertising.

E Record-keeping or invoice requirements.

F Minimum specification for reprocessed oil established.

G Bottle segregation required.

conservation of limited underground petroleum stocks. 11/

The California 3rd District Court of Appeals upheld both the legality of the labeling statute and its applicability to rerefined products. The court opined that the public has a right to know what it is buying. The public's preference for virgin products might be "founded entirely upon prejudice, which, in turn, is founded on ignorance;" nevertheless, because the public should not be led through the absence of labeling into buying something it does not desire, reprocessed lubricating products must be distinguished by labeling from virgin lubricating products.12/ The court, in its unanimous decision, did not address Paraco's resource conservation claims.

In Double Eagle Lubricants v. Texas, 13/ the Double Eagle Refining Company sought an injunction against enforcement of Texas' labeling statute. 14/ Double Eagle contended that the Federal Government had preempted the regulation of used oil labeling, so that state regulation could not be allowed to stand. Double Eagle also maintained that the Texas statute placed an undue burden on interstate commerce.

In upholding the legality of the Texas labeling law, the court reasoned as follows: in the area of federal-state jurisdiction covering the same subject matter, federal law is paramount if Congress has clearly indicated an intention to preempt the field. 15/ No such clear statement of Congressional intent is found in the Federal Trade Commission Act. Therefore, state laws providing for regulation of unfair or deceptive practices in commerce are valid unless they conflict so much in the same area with federal law that both cannot stand. 16/ No conflict exists between the phraseology and intent of the Federal Trade Commission order and Texas law at issue in this case. 17/ The Texas law, a valid exercise of the state's police power is reasonable in its requirements. It incidentally affects but does not discriminate against interstate commerce. 18/

FEDERAL OIL LABELING REQUIREMENTS

Since 1940, the FTC has concerned itself with the trade practices of the oil reprocessing industry. In the twenty-four year period 1940-1964, the Commission issued 17 orders and agreed to 26 stipulations involving individual oil reprocessors. In 1964, it promulgated a trade industry regulation applying to all oil reprocessors' marketing practices.

Early FTC Action

Beginning in 1940, the FTC challenged reprocessors' affirmative misrepresentation of their products. Individual reprocessors were ordered, or agreed in stipulations, to end labeling as "100% Pennsylvania Oil" products made from reprocessed crankcase drainings. 19/ In some cases, misrepresentation involved products whose trade names (e.g., "Cert-o-Penn") could lead consumers to believe they were purchasing lubricating oil refined from Pennsylvania crude. 20/ In addition to ordering the end of affirmative misrepresentation or products, the Commission required reprocessors to disclose that their products were made from previously used oil. The Commission, in so ordering, observed that the public had a preference for new oil and was therefore entitled to know the origin of its oil purchases. 21/

From its early cases involving both affirmative misrepresentation and non-disclosure, the Commission moved into the arena of simple non-disclosure, wherein it sought to require reprocessors to indicate on containers that their products had been reprocessed from used lubricating oils. In these cases, for which stipulations and orders were first reported in 1956, Commission staff maintained that since the public preferred virgin products to reprocessed products, any reprocessed oil containers not indicating that its contents had been manufactured from previously used oil was deceptive, for in the absence of such disclosure, the public assumed it was purchasing a virgin oil product. 22/ The FTC staff argued, further, that in these proceedings, the reprocessors' contentions that their products were equivalent in quality to virgin oil products were immaterial. 23/ Four FTC decisions and court rulings following from them have been selected for detailed examination here, for they highlight the major issues attending oil container label regulation.

The Mohawk Case

In the Mohawk Case, 24/ the Commission staff obtained testimony from retailers and consumers to the effect that when they bought oil not labeled as "reprocessed" they assumed they were purchasing virgin oil. 25/

Testimony revealed consumer preference for virgin lubricating oil though purchase choice seemed more greatly influenced by price and brand name considerations. 26/ Those preferring virgin lubricating oil to reprocessed lubricating oil indicated that they had no factual basis for their preference, but assumed that the virgin lubricating oil was better. 27/ However, a few indicated that they would purchase reprocessed oil if it could be proved to be equivalent in quality to new oil. 28/

Mohawk's expert witnesses testified that within the industry, purchases were made on the basis of specifications of finished oil, not on the basis of feedstock source 29/ and that virgin crudes from various parts of the United States differed from one another in their lubricating quality. 30/ They also indicated that virgin lubricating oil marketers, except for those selling Pennsylvania oil, did not reveal the sources of the crude feedstock they used in their lubricating oil refining processes and that the public, in its purchasing, was not interested so much in sources as it was in the finished lubricating oils' SAE and API ratings. 31/

The hearing examiner ruled against Mohawk. 32/ He rejected its argument that if it was required to disclose the source of its feedstock, then marketers of virgin lubricating oil should be subject to similar disclosure requirements. 33/ A cease and desist order was entered which was upheld on appeal to the Commission. The final Commission order read as follows:

> It is ordered, that respondents, Mohawk Refining Corp. . . in connection with the offering for sale, sale and distribution of lubricating oil in commerce, as "commerce" is defined in the Federal Trade Commission Act, do forthwith cease and desist from:
> (1) Representing, contrary to the fact, that their lubricating oil is refined or processed from other than previously used oil;
> (2) Advertising, offering for sale or selling, any lubricating oil which is composed in whole or in part of oil which has been reclaimed or in any manner processed from previously used oil, without disclosing such prior use to the purchaser or potential purchaser in advertising and in sales promotion material, and by a clear and conspicuous statement to that effect on the container. . .34/

Mohawk appealed the FTC order to the Third Circuit Court of Appeals. 35/ It contended that the FTC opinion and final order were arbitrary and capricious and lacked substantial supporting evidence; that the Commission erred in holding that failure to disclose the source of Mohawk's lubricating oil product was a violation of the Federal Trade Commission Act; and that the Commission had erred in excluding testimony from the hearing record pertaining to the selling practices of lubricating oil marketers. 36/ The court unanimously upheld the FTC actions, ruling as follows: The public prefers new oil to reprocessed used oil. Though the two might be equivalent in quality, the public is being misled if it purchases used oil that it believes to be new; "the public is entitled to get what it chooses, though the choice may be dictated by caprice or by fashion or perhaps by ignorance." 37/ Labeling is therefore necessary to distinguish new oil from used oil. Furthermore, the Commission did not err in excluding expert testimony to the effect that it was industry practice not to disclose to wholesale or retail purchasers the sources of motor oils, but rather to sell oil on the basis of SAE grades and API service classifications.

These facts are immaterial, because the record also indicated a desire on the part of dealers and the public not to sell or buy rerefined motor oil. 38/

Double Eagle I Case

The Double Eagle I matter 39/ was decided by the FTC on the same day as Mohawk, February 14, 1958, and it had the identical outcome.

Double Eagle argued that its rerefined product was equal in quality to lubricating oil refined from virgin crude and that to label it as being made from used oil would mislead an ignorant public into believing it was a low grade product. Double Eagle contended it would be unfair to require the use of a label which would cause the public to undervalue its product and thereby decrease sales. 40/ The rerefiner also contended that it performed a public service by providing proper disposal of waste oil. 41/

The full Commission responded that assertions of qualitative equality were "immaterial" to its considerations, for it was solely concerned with the question of whether the public was led to purchase rerefined oil out of the mistaken belief that it was buying virgin lubricating oil. 42/ The Commission added that if consumers have a preference for virgin goods, such a preference cannot be satisfied by imposing upon them an article similar to a virgin one but having a non-virgin origin. 43/ The Commission added, while upholding a hearing examiner's earlier decision, that the rerefiner's "public service" argument was "without merit." 44/ A cease and desist order similar to that in Mohawk was entered.

The Double Eagle Refining Company brought suit in the 10th Circuit Court of Appeals in 1959 seeking to reverse the FTC order. 45/ The court majority, over a vigorous dissent, sustained the FTC action. The dissenting judge based his opinion on the assumption that rerefined oil was qualitatively equivalent to oil refined from virgin crude. He reasoned as follows: Nothing can be found in the record to sustain a finding that the public prefers new lubricating oil; the one witness describing public attitudes stated that purchasers desire quality and prefer brand names. 46/ Omission of feedstock source information has no relation to product quality and absent "affirmative misrepresentation" it is quality that is material in determining whether there is customer deception. The fact that a buyer desires a good oil or a brand name oil does not mean he has any interest in the oil's origin. The assumption that the public prefers virgin oil does not follow from the fact that the public seeks good oil; yet the Commission made such as assumption, and from it found deception. 47/

Royal Oil

The Royal Oil Corporation matter 48/ was decided two months after the Mohawk and Double Eagle I matters. Prior to the filing of an FTC complaint against it, Royal Oil, a Maryland company, had been labeling its reclaimed oil as "re-processed," in compliance with a North Carolina statute. 49/ The FTC staff contended that though required by North Carolina law, this label did not adequately disclose the used oil origins of the reclaimed product. 50/ The FTC hearing examiner agreed and issued a cease and desist order similar to those described above. 51/ The full Commission affirmed the examiner's decision, declaring that FTC action was not incompatible with state action. 52/

The Royal Oil Corporation challenged the FTC order in the 4th Circuit. 53/ Royal argued that the FTC had no authority to require any disclosure beyond that required by state laws. Royal maintained that Congress had not entered this field of regulation, and thus the FTC could not nullify a valid state statute. 54/

The Fourth Circuit panel unanimously upheld the FTC action, reasoning as follows: Congress, through the Federal Trade Commission Act, has given the Commission broad authority to restrain unfair competition. Unless Congress specifically withdraws this authority, within particular areas, the Commission can restrain unfair business practices, even if these have been subject to state regulation. Furthermore, the Commission can order halted an unfair method of competition authorized by state law. 55/ The FTC action, moreover, does not deprive the company of equal protection under North Carolina law, though its inter-state marketed products may be subject to stiffer disclosure restrictions than its North Carolina competitors' intra-state marketed products; intra-state competition is not subject to federal regulation even though it competes with interstate commerce, and the FTC does not lose its interstate commerce jurisdiction merely because interstate goods are in competition with intrastate goods beyond federal control. Finally, although the testimony in the record is not very strong as to possible deception of the public stemming from incomplete label disclosure, it gives some indication that deception might occur. This, coupled with the Commission's own observations based on expert knowledge, is sufficient evidence that the labels can be deceptive. 56/

Double Eagle II

In 1963, the Double Eagle Company became the target of a second FTC complaint. In a resulting 1964 order 57/ the full Commission decided that the company's compliance with previous full disclosure rulings was inadequate. In this instance, the Commission reversed an examiner's finding that no deception of the public had occurred. 58/

The second Commission action against Double Eagle was evidently prompted by a change in the FTC's standards of full-disclosure. While in 1958 the Commission felt that the full disclosure goal was adequately served by having a notice of previous use printed on side panels of oil containers, by 1961 the Commission decided that only front panel printing of a previous use disclosure would meet this goal. This change in standards caused the Double Eagle Company, which had altered its labeling to conform to a 1958 Commission order, to fall into non-compliance.

In reaching its Double Eagle II decision, the Commission decided that it did not have to examine the hearing record for evidence of whether deception had been testified to, for its own visual examination of the containers involved was adequate for deciding if deception was likely to occur. 59/ The Commission found that it was and issued a cease and desist order requiring front panel disclosure on Double Eagle's labels. 60/

Double Eagle petitioned the Tenth Circuit to review the FTC order. 61/ The court upheld the Commission, noting that though many members of the public might testify that they had not been deceived, the Commission was acting within its discretion when, exercising its expert knowledge, it decided on the basis of visual inspection that Double Eagle's container labels were deceptive. 62/

Trade Regulation Ruling

Having ruled on a number of cases involving individual reprocessors, 63/ the Commission ultimately decided to establish a trade regulation, governing sales of reprocessed oil. The regulation, 64/ established after a public hearing, addressed many of the issued discussed in earlier agency decisions. In response to re-refiner assertions that they performed a public service in disposing of waste oil and that their products were as good as or better than many oils produced entirely from virgin crude stock, the Commission commented:

> The value of the service rendered by this industry is not germane to this consideration, nor is the quality of reclaimed oil involved here. It is not necessary therefore for the Commission to pass upon the relative merits of new and reclaimed oil. 65/

The Commission determined in its ruling that it constitutes an unfair method of competition and an unfair and deceptive act a) to represent used lubricating oil as new and unused; b) to fail to disclose clearly and conspicuously that such used lubricating oil has been previously used, and c) to use the term "rerefined" to describe previously used lubricating oil unless the physical and chemical contaminants acquired through previous use had been removed by a refining process. 66/

Although the Commission contended that oil quality was not germane to its proceedings, it had nevertheless obtained information from technical experts on the quality of rerefined oils. Research submitted to the Commission disclosed that reprocessed lubricating oils were of questionable durability. It was speculated that removal in the rerefining process of some of these oils' important components produced this shortcoming. 67/

In 1971, FTC Chairman Miles Kirkpatrick made the following comments concerning reprocessed oil quality:

> Technical experts...are convinced that actual performance capabilities of rerefined oil vary greatly in stringent requirement areas such as motor oil because of the unknown origin of the waste oil. Although the purity of rerefined oil...can possibly be controlled by laboratory specifications and testing, apparently many experts are convinced that equally important characteristics such as durability under in-use conditions cannot be determined without extensive performance testing. 68/

Kirkpatrick added that the Commission would re-examine its labeling rule when "valid, impartial, scientific tests" are available indicating that rerefined used motor oil is equal in quality and performance to an acceptable grade of virgin motor oil. 69/ His comments suggest that while the FTC did not officially weigh product quality in its proceedings, its action in promulgating a trade rule may have been in part motivated by a feeling that rerefined oil, though it met lab specifications, might differ in its durability characteristics from oil refined from virgin crude.

Impact of FTC Trade Regulation Action

The rerefiners contend that the FTC trade regulation ruling hurt them economically. 70/ They maintain that many middlemen marketing their products simply ceased handling them so as to avoid a relabeling burden. 71/ They also contend that the labeling decision changed their competitive position in the marketplace by altering retailers' shelf-stocking habits. Prior to the decision, apparently, rerefined oils competed directly with the more expensive, high quality virgin lubricating oils, but following the decision, the reprocessed products were placed in shelf locations where they competed against somewhat less expensive low quality virgin lubricating oils. 72/ Little data is available either to support these contentions or to refute them.

Post-Trade Regulation FTC Action

In 1972 the FTC began to reconsider its trade regulation ruling. The reevaluation is part of a broader study of labeling rules affecting "recycled" products.

Commission staff have met with EPA and Association of Petroleum Rerefiners (APR) representatives, and have been furnished information by the rerefiners on the quality of reprocessed oil. The staff has prepared a labeling proposal for consideration by the full Commission. It is presently undergoing review.

Proposals for Changing Label Requirements

EPA Proposals -

EPA staff have suggested that FTC consider establishment of labeling guides for recyled materials. 73/ Products made from recyled material with performance characteristics which are essentially comparable to those of products made from virgin materials would be treated as new and would not be required to make a prominent "new" or "recycled" disclosure. Products containing more than a specified percentage of recycled material (i.e., post-consumer waste) could be labeled as "recycled," if the manufacturer so desires and recycled products inferior in quality to virgin products would have to have their limitations disclosed. Previously used products subjected to little or no reprocessing would have to be labeled as "used."

The National Oil Recycling Act -

H.R. 5902, introduced by Representative Charles Vanik takes a somewhat different approach from EPA's to the labeling question. 74/ Section 3(2) of the Vanik bill defines "recycled oil" as used oil which has been rerefined or otherwise processed to remove the physical and chemical contaminants acquired through use, which by itself or when blended with new oil or additives is substantially identical or superior to new oil intended for the same purposes. Section 7(a) of the bill requires that recycled oil shall be labeled as such when packaged for sale.

The EPA and Vanik Proposals - An Evaluation

Under the EPA proposals, reprocessed oil would appear to fall under two labeling categories. On the one hand, for that reprocessed product equivalent in quality to new oil, no prominent source disclosure would have to be made. On the other hand, for that reprocessed product containing more than a specified percentage of recycled material (i.e., crankcase drainings, which are a post-consumer waste), then regardless of quality, a "recycled" label would be in order. As they apply to waste oil, the guidelines are ambiguous - a reprocessed product equivalent in quality to new oil yet containing more than a specified minimum percentage of reprocessed oil could fall within either of the two regulatory guidelines just described.

Vanik would label all reprocessed blends as "recycled" if they were equivalent in quality to virgin oils but his bill does not require that such blends contain more than a specified amount of reprocessed oil to qualify for this label. In addition, his bill selects high quality reprocessed oil for special labeling treatment. But unless sales of recycled oil would be assisted by this procedure, there seems to be no compelling reason to require special labeling.

The Question of Quality -

An alternative approach to both the Vanik and EPA proposals would be for all lubricating oil products, regardless of their feedstock source, to be subjected to engine and lab tests to determine specifications, and to have the specifications be the only labeling requirement. The matter of quality would need to be resolved in any case as a first step in determining product equivalence for purposes of labeling under both the Vanik and EPA proposals.

Considerable controversy presently exists as to whether rerefined oils are equivalent in quality to virgin lubricating oils. In question are not only equivalence in lab specifications but equivalence as well in engine performance tests. In June 1973 the rerefiners furnished the FTC with results from an Armour Research Foundation study of used oil drainings from throughout the country. 75/ Armour reported that the drainings were rather uniform in composition, more uniform in composition than virgin crude oils from different geographic areas of the United States. The rerefiners assert that this finding is significant because it means that a rerefiner's feedstock is fairly uniform, thereby eliminating the need for running expensive engine performance tests to assess the quality of each batch of rerefined oil. The rerefiners also furnished the results of a 1953 survey of rerefined oils that disclosed product uniformity.

The rerefiners have always argued that their rerefined product is equivalent in quality to virgin lubricating oils, but it is unclear whether this equivalence is for lab tests, engine performance tests, or both. As noted previously, research submitted to the FTC questioned the durability of reprocessed oil. 76/

Some Defense Supply Agency procurement specifications explicitly preclude the acquisition of reprocessed oil. 77/ A DSA study indicated that the primary cause for the prohibition is the lack of substantiating data on the quality of rerefined oil stocks. 78/ The study reported that little if any test information is available on how the quality of rerefined is affected by such variables as treatment method and waste oil feedstock composition. 79/ DSA reported Bureau of Mines tests on rerefined oil as indicating that many metal contaminants of waste oil can be substantially removed by rerefining, but the effect of rerefining on oil performance characteristics is not known. 80/ The DSA study concluded that the Defense Department should initiate a program to develop specifications for an automotive lubricating oil containing rerefined stocks. 81/

Conclusions -

While the FTC ostensibly did not take product quality and environmental impact into consideration at the time it promulgated its trade regulation ruling, law and reason require that future rulings consider both. First, Sections 101 and 103 of the National Environmental Policy Act of 1969 require FTC to re-examine its action and to take its environmental impact into account. 82/ Second, since under both the EPA and Vanik proposals product quality would have to assessed, and since there is considerable variation among virgin lubricating oil sources, it would seem that any proposal for new labeling action should be predicated on the establishment of quality specifications.

Research on product quality is presently under way at the Bureau of Mines and such research has been proposed by the Defense Supply Agency. If quality specifications and simple testing procedures can be established, and products can be compared on the basis of their lab and performance specifications, it would seem that, in the absence of both intra-industry concern with feedstock source and national consumer preferences regarding feedstock source, there would be little purpose served by distinguishing virgin oils from reprocessed oils.

FOOTNOTES

1/ Arkansas: Tit. 41, §41-1918 Arkansas Stats. '64.

Colorado: Ch. 100, §100-2-16 Colorado Revised Statutes '63.

Connecticut: Tit. 14, Ch. 250, 14-342(a), Conn. Gen'l. Stats. '58.

Florida: Tit. 31, Ch. 526, §526.01(1), Fla. Stats. Anno. '72.

Georgia: Tit. 73, §73.222(A)(3) Code of Georgia.

Maine: Tit. 10, Ch. 307, §1654 Maine Revised Statutes '64.

Maryland: Art. 27, §231(a) Ann. Code of Public Gen'l. Laws of Md. (1971).

Michigan: §75.241(1), Michigan Compiled Laws Anno. '68.

Missouri: Tit. 26, Ch. 414, §414.150 Ann. Missouri Stats.

Nebraska: Ch. 66, §66-318, Rev. Stats. of Nebraska.

New Jersey: Tit. 51, Art. 1, §51:4-1, New Jersey Stats. '70

New York: Art. 26, §391-a(1), McKinney's Consolidated Laws of N. Y. Annotated '68.

Oklahoma: Tit. 52, Ch. 7, §391, Oklahoma Stats. '69.

Ohio: Tit. 37, §3741.17 Ohio Revised Code Ann.

South Carolina: Ch. 6, Art. 4 §66-461, Code of Laws of South Carolina '62.

West Virginia: Ch. 47, Art. 10 §47-10-1 W. Va. Code Anno. (1966).

Illinois once had a general deception law (Ch. 104, §15, Illinois Annotated Statutes 1935), but this was repealed in 1969.

2/ Title 31, Ch. 526, §526.01(1), Fla. Stats. Anno. '72.

3/ See discussion in text accompanying footnotes 22-62.

4/ Alabama: Tit. 2, §437(1)-(4), Code of Alabama (Recompiled) (1958).

California: Div. 8, Ch. 7, Art. 4, §20800 et seq. Cal. Bus. & Prof. Code.

Colorado: Ch. 100, §100-2-13, Colorado Rev. Stats. '63

Connecticut: Tit. 14, Ch. 250, §14-342(c), Conn. Gen'l. Stats. Anno. 1958.

Florida: Title 31, Ch. 526, §526.01(2)(a)-(3), Fla. Stats. Anno. '72

Georgia: Tit. 73, §73-222(4), Code of Georgia of 1933.

Idaho: Tit. 37, §37-2514 et seq. Gen'l. Laws of Idaho Anno. '64.

Illinois: Ch. 104, §101 et seq., Ill. Stats. Anno. (1973 Pocket Part).

Indiana: Tit. 35, §35-4016, Annotated Ind. Stats. 1969.

Louisiana: Ch. 2, §51-901, La. Rev. Stats. Anno. '65

Maryland: Art. 27, §231(a), Ann. Code of Public Gen'l. Laws of Md. '72.

Massachusetts: Ch. 94, §295F, Mass. Gen'l. Laws Anno. '72

Mississippi: Tit. 75, Ch. 55, §75-55-13 of Miss. Code Anno. '72.

Missouri: Tit. 26, Ch. 414, §414.150(2), Ann. Mo. Stats.

Nevada: §590.060(4), Nevada Revised Stats. 1971.

New Mexico: Ch. 65, §65-6-12 et seq., New Mex. Stats. Anno., 1971.

New York: Art. 26, §391-a(5), McKinney's Consolidated Laws of N.Y. 1968.

North Carolina: Ch. 1137, Art. 2A, §119-13.1-13.3, Gen'l. Stats. of N.C.

Texas: Art. 1106(b), Vernon's Ann. P.C.

Wisconsin: Tit. 16, Ch. 168, §168.14(1)-(2), Wisc. Stats. Anno. '57.

5/ Colorado, Connecticut, Florida, Georgia, Maryland, Missouri, New York. See Footnotes 1 and 4 supra.

6/ See text accompanying Footnotes 64-66 infra.

7/ 257 P.2d 981 (3rd Dist. Ct. of Appeal, Cal., 1953).

8/ Div. 8, Ch. 7, Art. 4 §20800 et seq., Cal. Bus. & Prof. Code Anno. These sections declare that: crankcase drainings, lube distillate or any other petroleum product shall not be sold for use as lubricating oil in an internal combustion engine unless free from water or suspended matter and possessing certain flash point ratings; that if lubricating oil sold has been previously used for lubrication of such engines, or gears or shafts attached thereto or for any lubricating use or has been rerun or filtered, redistilled or claimed the container shall be labeled "reclaimed motor oil" or "lubricating oil reclaimed" in red letters of specified type and size; that anyone who buys, sells or stores lubricating oil required to be so labeled shall keep records of purchases, sales and storage.

9/ Paraco, supra note 7, at 983.

10/ Id. In this regard, it should be noted that the state could only enforce the labeling statute by checking Paraco's records, because it was impossible to determine by any test whether an oil was virgin stock or rerefined.

11/ *Id*.

12/ *Id*. at 985.

13/ 248 F. Supp. 515 (N.D. Texas, 1965).

14/ Art. 1106(b) Vernon's Ann. P.C.
"(b) No person, firm, association of persons or corporation shall sell or offer for sale as lubricating oil, any oil that has been rerun, refiltered, reclaimed or refined from crank case draining or any other oil that has been theretofore used for purposes of lubrication, unless the said oil is sold as and labeled 'Reconditioned Motor Oil'. The words 'Reconditioned

Motor Oil' shall be plainly and legibly printed on each container, which said lettering shall be imprinted in two (2) places on the container or label in a manner that said lettering will appear both on the front and back surface of the container when displayed to the public in sale displays, and which said lettering shall be in letters of not less than three-sixteenth (3/16) of an inch in height and not less than one-sixteenth (1/16) of an inch in the width of each line used to form said letters." Also see discussion in text accompanying footnotes 57-66.

15/ Double Eagle, supra note 13 at 517.

16/ Id. at 518.

17/ Id.

18/ Id. at 519.

19/ Economy By-Products Co., Inc., Stip. No. 2920 (August 27, 1940); Mouren-Laurens Oil Co., et al, Stip. No. 3301 (December 8, 1941); Free State Oil Co., Stip. No. 3584 (December 11, 1942); In the Matter of Penn-Lab Oil Products Co., Docket No. 4524, 34 FTC 1049 (1942); In the Matter of Westville Refinery, Inc., Docket No. 4370, 36 FTC 402 (1943); In the Matter of Dabrol Products Corp. et al, Docket No. 5656, 47 FTC 791 (1950).

20/ In one proceeding, the FTC found the trade name and corporate name alone misleading, even though there was no claim made that the product was refined from 100% Pennsylvania crude. See in the Matter of Pennsylvania Oil Terminal, Inc., et al, Docket No. 5868, 48 FTC 356 (1951).

21/ Westville Refinery, *supra* note 19 at 405, 406.

22/ As in all the reprocessed oil proceedings, the bases of FTC authority were sections 5(a)(1) and 5(a)(6) of the Federal Trade Commission Act, 15, U.S. C. §45 (a)(1) and §46(a)(6), which declare unfair methods of competition and unfair or deceptive practices in commerce to be unlawful and which empower the Commission to prevent their use.

23/ See discussion infra accompanying footnotes 68-69.

24/ In the matter of Mohawk Refining Corp. et al., Docket No. 6588, 54 FTC 1071 (1958).

25/ "Transcript of Proceedings before Hearing Examiner J. Earl Cox in the matter of Mohawk Refining Corporation, at 8, 35, 159, 197, 209, 215.

26/ Id. at 8, 13, 142, 166, 171, 176, 188, 191, 202-202, 205, 253, 347.

27/ Id. at 17, 18, 173, 180, 191, 227.

28/ *Id*. at 143, 181, 192-193, 205, 217, 228.

29/ *Id*. at 242-254.

30/ *Id*. at 93-96.

31/ *Id*. at 256, 261, 270.

32/ *Supra*, note 4, at 1074.

33/ *Id*. at 1073.

34/ *Id*. at 1078.

35/ Mohawk Refining Corp. et al v. FTC, 263 F 2d 818, (3rd Circ., 1959) 1959 Trade Cases, 69,276.

36/ *Id*.

37/ *Id*. at 69,277 citing FTC v. Algoma Lumber Co., 291 U.S. 67,77-78 (1934).

38/ Id.

39/ In the Matter of Frank M. Kerran et al Doing Business as Double Eagle Refining Co., Docket No. 6432, 54 FTC 1035 (1958).

40/ Id. at 1040.

41/ Id.at 1041.

42/ Id. at 1039.

43/ Id. at 1040.

44/ Id. at 1041.

45/ Kerran et al v. FTC, 265 F.2d 2461 (10th Circ., 1959) 1959 Trade Cases, 69,322

46/ Id.

47/ *Id*.

48/ In the matter of Royal Oil Corp. et al, Docket No. 6702, 54 FTC 1292 (1958).

49/ Royal Oil marketed its oil in North Carolina. Chapter 119, Section 119-13.1-13.3, General Statutes of North Carolina: Section 119-13.2 reads as follows: Labels required on sealed containers; oil to meet minimum specifications.--It shall be unlawful to offer for sale or sell or deliver in this State re-refined or re-processed oil, as hereinbefore defined, in a sealed container unless this container be labeled or bear a label on which shall be expressed the brand or trade name of the oil and the words "re-processed oil" in letters at least one-half inch high; the name and address of the person, firm, or corporation who has re-refined or re-processed said oil or placed it in the container; the Society of Automotive Engineers (S. A. E.) viscosity number; the net contents of the container expressed in U.S. liquid measure of quarts, gallons, or pints; which label has been registered and approved by the Gasoline and Oil Inspection Division of the Department of Agriculture; and that the oil in each sealed container shall meet the minimum specifications as hereinbefore described for each Society of Automotive Engineers (S. A. E.) viscosity number.

50/ Royal Oil, supra note 48 at 1292.

51/ Id. at 1298.

52/ Id. at 1299-1303.

53/ Royal Oil Corp. et al v. FTC, 262 F.2d 741 (4th Circ., 1959), 1959 Trade Cases 69,324.

54/ Id.

55/ Id.

56/ Id. at 69,235.

57/ In the Matter of Double Eagle Lubricants et al, Docket No. 8589, 66 FTC 1039 (1964).

58/ Id. at 1055.

59/ Id. at 1066.

60/ Id. at 1068.

61/ Double Eagle Lubricants et al v. FTC, 360 F.2d 268 (10th Circ., 1965), 1965 Trade Cases 71,613.

62/ Id/ at 71,614.

63/ Orders:
In the Matter of Salyer Refining Company, Inc.. et al, Docket No. 6339, 54 FTC 1026 (1958); In the Matter of High Penn Oil Company, Inc., Docket No. 6492, 53 FTC

256 (1956); In the Matter of Deep Rock Refining Co., Docket No. 6579, 54 FTC 1123 (1958); In the Matter of Acme Refining Corp. et al, Docket No. 6581, 54 FTC 1126 (1958); In the Matter of Lincoln Oil Co. et al, Docket No. 6669, 54 FTC 1080 (1958); In the Matter of Supreme Petroleum Products, Inc., Docket No. 6682, 54 FTC 1129 (1958); In the Matter of Allied Petroleum Corp., et al, Docket No. 6709, 54 FTC 1132 (1958); In the Matter of Seaboard Oil Co., et al, Docket No. 6717, 54 FTC 1135 (1958); In the Matter of Pierce Oil & Refining Co., et al, Docket No. C-80, 60 FTC 342 (1962); In the Matter of Porte Manufacturing Co., Inc. et al, Docket No. C-586, ___ FTC ___ (   ). Stipulations were agreed to in the following cases: Virginia Iron & Metal Co., Inc., et al, Stip. No. 8784 (June 19, 1956); S & R Oil Co., Stip No. 8785 (June 19, 1956); Pioneer Oil Co., et al, Stip. No. 8786 (June 19, 1956); Thompson Chemical Co., Stip No. 8831 (November 6, 1956); United Oil & Grease Co., et al, Stip. No. 8834 (November 6, 1956); Jenney Manufacturing

Co., Stip. No. 8835 (November 6, 1956); Quincy Oil Co., et al, Stip. No. 8841 (December 11, 1956); Pacific Oil Co., et al, Stip. No. 8852 (January 1, 1957); Three Rivers Refining Co., et al, Stip. No. 9124 (November 18, 1958); Warren Oil Co., et al, Stip. No. 9218 (September 1, 1959); Christopher Oil Company, Stip. No. 9286 (May 12, 1960); State Wide Oil Company, Stip. No. 9290 (May 26, 1960); Top Oil Co., Inc., et al, Stip. No. 9369 (December 13, 1960); Searle Petroleum Co. of Neb., et al, Stip. No. 9380 (January 12, 1961); Wynne Oil Co., et al, stip. No. 9384 (January 31, 1961); Kincheloe Oil Company (Industrial Oil Works Company), Stip. No. 9386 (February 16, 1961); Beckett Brothers, et al, Stip. No. 9388 (February 16, 1961); Henley Oil Co., et al, Stip. No. 9434 (May 25, 1961); Tulsa Refined Oil Company, et al, Stip. No. 9457 (July 13, 1961); Graham Penn Oil Co., et al, Stip. No. 9464 (July 18, 1961); R. E. Moore Co., et al, Stip. No. 9471 (August 3, 1961); Jackson Oil Products Co., et al, Stip. No. 9473 (August 23, 1961).

64/ "Trade Regulation Rule Relating to Deceptive Advertising and Labeling of Previously Used Lubricating Oil," 16 CFR 406. (Adapted July 28, 1964; effective September 1, 1965).

65/ Id. (Slip text at 4).

66/ Accordingly, for the purpose of preventing such unlawful practices, the Commission hereby promulgates, as a Trade Regulation Rule, its conclusions and determination that in connection with the sale or offering for sale of lubricating oil composed in whole or in part of previously used lubricating oil, in commerce, as "commerce" is defined in the Federal Trade Commission Act, it constitutes an unfair method of competition and an unfair and deceptive act or practice to:
(1) Represent in any manner that such used lubricating oil is new or unused; or
(2) Fail to disclose clearly and conspicuously that such used lubricating oil has been previously used,

in all advertising, sales promotional material and on each front or face panel of the container. For the purpose of this rule the front or face panel means the part (or parts) of the container on which the brand name is usually featured and which is customarily exposed to the view of prospective purchasers when displayed at point of retail sales; or

(3) Use the term "re-refined," or any other word or term of similar import, to describe previously used lubricating oil unless the physical and chemical contaminants acquired through previous use have been removed by a refining process.

67/ Letter to FTC dated June 5, 1964 from R.E. Streets, Chief, Power Sources Section, Chemistry and Materials Branch, Research Division, Research and Development Directorate, U.S. Army Material Command.

68/ Letter to Congressman Charles A. Vanik, August 19, 1971, at 2.

69/ *Id*.

70/ See "Message to President Nixon, Members of Congress, The Federal Trade Commission, Pollution Control Agencies & Others From Association of Petroleum Rerefiners" (December 1972) at 2.

71/ Interview with V. T. Worthington, Executive Director, Association of Petroleum Rerefiners, October 23, 1973.

72/ Oral Presentation by Teknekron Corporation, contractors to EPA, September 17, 1973.

73/ See "Solid Waste Disposal Act Extension, Hearing before the Subcommittee on Public Health and Environment of the House Committee on Interstate and Foreign Commerce, 93rd Congress, 1st Session, at 59.

74/ Introduced March 20, 1973, Congressman Vanik reintroduced the bill as H.R. 9338, H.R. 9339 and H.R. 9860, so as to add additional cosponsors for it in accordance with

House rules.

75/ Letter to William D. Dixon, Assistant Director, Rules & Guides, FTC, from V. T. Worthington, June 25, 1973.

76/ See text accompanying footnote 66.

77/ MIL Spec MIL-L-46152, MIL-L-2104C.

78/ "Waste Oil Recycling Study (September 1972).

79/ Id. at 33.

80/ Id.

81/ Id.

82/ Pub L. 91-190, 42 U.S.C. 4321-4347, Section 101(b)(6) of the law declares that the Federal Government should improve its plans and programs to "enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources. Section 103 requires federal agencies to review their policies and procedures as a first step in bringing them into conformance with the national environmental policy embodied in Section 101.

APPENDIX G

Federal and State Jurisdiction Over Waste Oils

CURRENT AND POTENTIAL FEDERAL JURISDICTION

A. DEFINITION OF WASTE OIL AND OF JURISDICTION ANALYZED

Not all oily wastes fall within the scope of the definition provided in section 104 (m) (1) of the FWPCA Amendments of 1972. That section calls for a study of the generally, effects and potential market of "*used* engine, machine, cooling and similar waste oil" (emphasis added). This definition excludes animal and vegetable oils and excludes unused mineral oil wastes, e.g., the wastes from drilling for, refining, or transporting petroleum. It includes mineral oils and mineral oil products which have been used in machines, motors, engines, compressors, cylinders, axles, transmissions, transformers, turbines, cable or circuit breaker insulations, and spindles.

This analysis of federal jurisdiction over disposal of waste oils within the boundaries of the United States and its territorial seas distinguishes between current and potential federal jurisdiction, i.e., that which presently grants regulatory authority over waste oil to an agency of the U.S. government and that which may do so in the future.

B. CURRENT JURISDICTION

1. Federal Water Pollution Control Act Amendments of 1972

a. Section 311

The definition of oil in section 311 (a) (1) includes a specific reference to "oil refuse" and is comprehensive enough to include waste oil as defined above. Section 311 (b) (3) prohibits the discharge of oil "into or upon the navigable waters of the United States /or/ adjoining shorelines" in quantities determined in regulations issued by the President to be harmful. By Executive Order No. 11735, issued August 3, 1973, the President delegated the authority to issue these regulations to the Administrator of the Environmental Protection Agency. The regulations were issued in September 1970 under the predecessor provision to section 311 (b) (3) and are regarded by the Agency as continuing in effect without being re-issued. They provided that a discharge is harmful if it leaves a visible sheen on the receiving water, a definition which withstood judicial review in *U.S. v. Boyd*, 3 ELR 20434, decided in April 1973. A discharge is defined by section 311 (a) (2) as including spilling, leaking, pumping, emitting, emptying or dumping. A harmful discharge must be reported to the Coast Guard and is subject to a civil penalty after notice and an opportunity for a hearing. Section 311 (b) (5)-(6), Executive Order No. 11735.

Section 311 (c) (1) authorizes the President to act to arrange for the removal of any oil discharge (whether or not in harmful amounts), a power which he has delegated to the heads of federal agencies having responsibility under the National Contingency Plan. This plan is required under section 311 (c) (2) for the purpose of providing for coordinated action to minimize damage from oil discharges. 36 F. R. 16215. The Council on Environmental Quality has been assigned the responsibilities of publishing and revising the plan. Exec. Order No. 11735.

Section 311(j)(1)(c) likewise authorizes the President to issue regulations establishing procedures, methods and equipment to prevent and contain discharges of oil from offshore non-transportation related facility or onshore facility. The President has delegated these responsibilities to the Administrator of the Environmental Protection Agency and the Secretary of the Department in which the Coast Guard is operating by Exec. Order No. 11735. EPA implemented this order in 40 CFR11Z.

b. Section 402

Direct discharges (i.e., not into a municipal sewer system) of waste oils in quantities less than harmful for purposes of section 311 (for example, by a firm which cleans fuel oil tanks or service station interceptors, e.g., the Metropolitan Sewer Cleaning and Pumping Association of Washington, D.C.) are governed by the requirement to obtain a permit contained in section 402 of the Federal Water Pollution Control Act Amendments of 1972. (Presumably, harmful discharges of oil prohibited by section 311 would not be eligible for a permit under section 402.)

Section 301 (a) proscribes the discharge of any pollutant (defined in section 502 (12) as any discharge from a point source into navigable waters, arguably giving broader jurisdiction than section 311, which refers to "navigable waters of the United States") unless the discharge is authorized by a permit under section 318, 402, or 404. It is not likely that section 318, concerning permits to discharge pollutants in connection with an aquaculture project, or section 404, concerning permits to discharge dredged or fill material, would be applicable. Section 402, however, would be. It authorizes the Administrator of the Environmental Protection Agency, after an opportunity for a public hearing, to issue a permit for the discharge of a pollutant or combination of pollutants "upon condition that such discharge will meet either all applicable requirements under sections 301, 302, 306, 307, 308 and 403 of this Act, or prior to the taking of necessary implementing actions relating to all such requirements, such conditions as the Administrator determines are necessary to carry out the provisions of this Act." Briefly, this means that the discharger must (1) meet by July 1, 1977, effluent limitations which shall require application of the best practicable control technology currently available, as defined by the Administrator of the EPA pursuant to section 304 (b) of the Act (section 301 (b)(1)(A));

(2) meet by July 1, 1977, any more stringent limitation established pursuant to state law or other federal law or regulation or required to meet water quality standards established pursuant to the Act (section 301 (b)(1)(C));

(3) meet by July 1, 1983, effluent limitations which shall require application of the best available technology economically achievable for a category or class of point source (section 301(b)(2)(A));

(4) meet -- if discharges in compliance with the effluent limitations established in accordance with section 301 (B)(2)(A) would interfere with the attainment or maintenance of water quality which will assure protection and propagation of a balanced population of shellfish, fish and wildlife, and allow recreation all activities in and on the water -- effluent limitations which can reasonably be expected to contribute to the attainment or maintenance of such water quality (section 302(s));

(5) meet -- for discharges from facilities listed by category by the Administrator of the EPA in accordance with section 306(b)(1)(A) -- federal standards of performance reflecting the greatest degree of effluent reduction determined by the Administrator to be achievable with the application of the best available demonstrated control technology, if the discharge is from a new source of that category, i.e., if construction of the facility was commenced after publication of proposed regulations by the Administrator for that category in accordance with section 306 (b)(1)(B) (section 306(e));

(6) meet effluent standards or prohibitions for toxic pollutants (defined by section 502(13)) listed by the Administrator of the EPA in accordance with section 307(a)(1) (section 307(d));

(7) monitor effluents as required in accordance with section 308(a)(A) and permit access in accordance with section 308(a)(B); and

(8) comply with guidelines issued by the Administrator for determining the degradation of the waters of the territorial seas in accordance with section 403(c).

c. Section 313

Section 313 of the FWPCA Amendments of 1972 provides that all federal agencies having facilities or conducting activities which may result in the discharge of pollutants "shall comply with Federal ... requirements respecting control and abatement of pollution to the same extent as any person is subject to such requirements . . . ."

Discharges of oil without a permit, or in violation of its conditions, are liable to suit in accordance with section 309 or 505 of the Federal Water Pollution Control Act Amendments of 1972 and with section 17 of the Rivers and Harbors Appropriations Act of 1899, in addition to the liability to civil penalties for harmful discharges established by section 311(b)(6).

d. Section 208

Section 208(b)(3) gives the Administrator of the EPA authority to approve areawide waste treatment management plans submitted by state governors for areas which have substantial water quality control problems. These plans must include "a process to control the disposal of pollutants on land or in subsurfaces excavations within the area to protect ground and surface water quality. Section 208(b)(2)(k). The Governor must designate a waste treatment management agency for the area which the Administrator must accept unless the designated agency does not have adequate authority to implement the plan. Section 208(c).

2. Marine Protection, Research and Sanctuaries Act of 1972

Discharges of amounts of oil into territorial waters which are not prohibited as harmful under section 311(b)(3) of the Federal Water Pollution Control Act Amendments of 1972 are not covered by section 402 of the Act. Rather they are covered by the permit program established by section 102 of the Marine Protection, Research and Sanctuaries Act of 1972. See comment 13(iii) on revisions to 40 C.F.R. Part 125, 1 ELR 46304. That section provides that the Administrator of the Environmental Protection Agency may issue permits for the transportation from the U.S. of material for the purpose of dumping it into ocean waters if he determines that such dumping will not unreasonably degrade or endanger human health, welfare, or amenities, or the marine environment, ecological systems or economic potentialities. Section 102 also directs the Administrator to establish and apply criteria for reviewing and evaluating permit applications.

Part 227 of 40 C.F.R. contains the EPA's criteria for evaluation of permit applications for ocean dumping issued under authority of Title I of P.L. 92-532. Section 227.22 provides:

> "Subject to the exclusion of paragraph (h) of this section, the dumping, or transportation for dumping, of wastes containing the following materials as other than trace contaminants will not be approved by EPA.
>
> (d) Crude oil, fuel oil, heavy diesel oil, and lubricating oils, hydraulic fluids, and any mixtures containing these, taken on board for the purpose of dumping, insofar as these are not regulated under P. L. 92-500."

This is so even though the definition of "material" in section 3 of the Marine Protection, Research and Sanctuaries Act of 1972 specifically provides that material "does not mean oil within the meaning of section 11 of the Federal Water Pollution Control Act," i.e., within the meaning of section 311(a) (1) of the FWPCA Amendments of 1972.

H. R. 5450 would amend the definition of material in section 3 to make clear that Congress intends to exclude oil only to the extent regulated under the Federal Water Pollution Control Act Amendments of 1972. Until this definition is amended the authority of EPA to deny applications to dump waste oils in the ocean is questionable.

3. The Clean Air Act

The disposal of waste oils by burning, either undiluted or combined with other fuels or matter, produces emissions of particulates. Some of the particulate matter is heavy metals, principally lead. These particulate emissions are controlled under the implementation plans for achieving national primary and secondary air quality standards for particulate matter prepared by the States in accordance with section 110 of the Clean Air Act, for approval by the Administrator of the Environmental Protection Agency. If the waste oils are burned by a stationary facility subject to standards of performance applicable to new sources of certain categories of sources (e.g., fossil fuel steam generators, Portland cement plants or large incinerators), under section 111 of the Act, then the particulate emissions must not exceed these standards of performance if the facility was constructed or modified after the publication data of the regulation containing the standards. See 40 C. F. R. 60.1.

C. POTENTIAL JURISDICTION

1. Clean Air Act, Section 112

If the administrator of the Environmental Protection Agency determines, as he has for mercury, beryllium and asbestos, that lead is a hazardous air pollutant, i.e., an air pollutant to which no ambient air quality standard is applicable and which may cause or contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness, then the burning of waste oils containing lead (e.g., crankcase drainings) will have to be conducted so as to comply with emission standards for lead adopted in accordance with section 112(b)(1)(B).

2. Hazardous Waste Management Act of 1973 (S. 1086, H. R. 4873)

Section 3 (4) of the Administration's bill governing the disposal of hazardous wastes on land defines hazardous wastes as "any waste or combination of wastes which pose a substantial present or potential hazard to human health or living organisms because such wastes are nondegradable or persistent in nature or because they can be biologically magnified, or because they can be lethal, or because they may otherwise cause or tend to cause detrimental cumulative effects." Should this bill or a modified version of it pass with this definition substantially intact it is likely that its provisions would apply to the disposal of waste oils. A report to the EPA by the Battelle Institute under section 212 of the Resource Recovery Act treated oils as hazardous.

The staff of Senate Commerce Committee's Subcommittee on Energy and the Environment is revising S.2753 for consideration by the Subcommittee at the end of February 1974. This bill would govern unsafe waste disposal practices and the disposal of hazardous wastes. It would establish guidelines for the disposal of all wastes from federal facilities and for unsafe disposal practices of non-hazardous wastes. For hazardous wastes certain practices and procedures would be prescribed. The determination of which wastes are deemed hazardous would be subject to the discretion of the Administrator of the Environmental Protection Agency. The proposed standard for inclusion on the list is "unreasonable risk to health and environment." EPA would also set standards to be met by mandatory state-administered permit programs governing generators, transporters and disposers of hazardous wastes. The bill defines wastes to include fluid and gaseous wastes.

3. Toxic Substances Act (S. 426)

Depending on what action the conference committee takes on this bill, its provisions could apply to waste oils.

CONCLUSION

These legal provisions do not offer comprehensive control of collection and disposal of waste oils. Additional control over collection is provided by some municipal fire prevention ordinances which require service stations to have underground tanks to store waste oils. These ordinances usually do not apply to other enterprises which generate waste oils, often in large quantities.

Disposal of waste oils by uncontrolled burning, by road oiling, by dumping on land, by putting it in the garbage or down the drain, by mixing them with fuel or house heating oils -- all of which have demonstrated or probable harmful effects -- is not adequately controlled by present laws. Nor do present state or federal laws either require waste oils to be saved or collected, or control how they are stored.

Section Three: Alternative Legal Approaches

I. INTRODUCTION

The findings of this report resulted in a recommendation that regulatory authority for the collection and disposal of waste oil should be vested in State and/or local authorities. This section presents several alternative methods for federal/state intervention if conditions change, and such intervention is warranted with respect to improving economic efficiency.

Defining alternative legal approaches to used oil problems requires knowing what problems are and what means would be feasible (technically, legally, administratively and economically) and effective in addressing the problems.

This section will state these potential problems generally: discuss what means could address them effectively; suggest several alternative approaches which could employ these means; analyze the federal-state-local relations, the advantages and disadvantages of, and the possible legislative vehicle for each alternative approach; and propose alternative possibilities for funding the alternatives.

II. THE PRINCIPAL PROBLEMS

There are two principal used oil problems. First, unknown amounts of lubricating oil are being used once and then disposed of. Second, many means of disposing of used oils may be causing unnecessary air, water and soil pollution.

III. MEANS FOR ADDRESSING THE PROBLEMS

A review of existing programs to control collection and disposal of used oils in the U.S. and abroad indicates that the following elements offer effective means for achieving comprehensive control.

1. Discharging used oils on land or in water, or burning them in other than properly equipped incinerators should be prohibited. Some programs proscribe giving used oils to other than officially approved collection or disposal facilities.

Such provisions are necessary to discourage such wasteful and harmful practices as dumping used oils down drains, into sewers, onto empty lots, or burning them in the open.

2. Persons or companies having more than specified minimum amounts (e.g., 50 gallons) of "clean" used oils should either be able to give them to authorized collection centers or have an approved collector pick them up without charge.

Disposing of severely contaminated used oils can be costly -- an alternative in such cases is to charge for picking up or accepting such wastes. Likewise it is usually uneconomical to collect less than certain minimum amounts. What the minimum is depends upon the costs of collection and the cost/revenue resulting from alternative waste oil uses. Approximately fifty gallons is the minimum amount in Germany.

If a person or company has to pay to have his used oils picked up he is tempted to dispose of them "for free" by dumping them somewhere. Likewise, if it is much less convenient to have them picked up or to give them to a proper collector, the same temptation will exist. For persons having less than the specified minimum of used oils, either municipalities should establish collection centers where they can be deposited for free or sales outlets for oil products should be required to accept them without charge.

3. If persons are to be able to give their used oils away or have them picked up, then there needs to be a corresponding capacity to either accept or collect them on a regular basis. These collectors or collection stations should be reliable. That is, they must have enough safe facilities to perform their functions and enough at stake to prevent them from disposing of the used oils improperly once collected. In many jurisdictions they must obtain a permit to do business based on a demonstration that their facilities are adequate. In some jurisdictions one may only give his used oils to a licensed collector.

4. Just as it is important that collection methods and facilities be approved, so it is that the means of "ultimate" disposal of used oils be carefully controlled.

There are many possibilities for ultimate disposal: incineration, rerefining, reprocessing prior to re-use, among others. Which of these possibilities are preferred or acceptable varies from place to place with varying circumstances. Whichever ones are acceptable must be carried out properly, however. For this reason, these operations should also be subject to supervision.

5. The best means for assuring compliance by collectors and disposers with the conditions of their doing business is that they maintain records of the transactions involved -- date, name, amount and kind of oil collected or transferred to a disposer, means of disposal, etc.

6. Compliance must also be checked by government officials and those subject to this supervision must make available the information the officials need to perform their functions. Proprietary information must be kept secret by these officials.

7. Those who violate the requirements outlined above must be liable to criminal sanctions and equitable relief must be available to remedy the violations. Some jurisdictions have provisions that holders of licenses will lose them for serious or repeated violations.

8. Many people do not know how to dispose of their used oils properly, nor why it is important to do so. A public information program to explain the reasons for proper disposal and the means for doing so is vital.

IV. ALTERNATIVE APPROACHES FOR IMPLEMENTATION

There are several alternative approaches which could implement the means discussed above for assuring comprehensive waste oil collection and disposal.

A. Interstate compacts
B. Public corporations
C. Grants-in-aid for government programs
D. Permits to sell, collect and dispose of oil products
E. Regulations requiring the oil industry to collect and dispose of their used products
F. Positive economic incentives for private entrepreneurs

A. INTERSTATE COMPACTS

Article I, section 10 of the U.S. Constitution provides that no state may enter into any agreement or compact with another state without the consent of Congress. With such consent, of course, states can and have entered into agreements designed to facilitate regional solutions to various kinds of problems. These agreements may also include the federal government as a party: the compact creating the Delaware River Basin Commission does this.

Bills containing the language of the proposed agreement and authorizing the governor to enter into the agreement must be enacted by each prospective state party. If the agreement also affects the political balance of the federal system, as many do, then it must likewise gain the formal consent of Congress before becoming effective. Examples of well-known and relatively effective agencies created by interstate compacts, in addition to the Delaware River Basin Commission, are the New York Port Authority and the Ohio River Valley Sanitary Commission (ORSANCO).

There are several issues which must be considered in working out a compact which will be effective. Should the powers of the agency created be research and advisory only, or should they include rule-making and enforcement powers? Should the federal government be represented as a party, an observer, or not at all? What should the membership of the agency be and what kind of political consitutency should it have? Should the agency's staff implement decisions or State personnel? How are jurisdictional conflicts to be resolved? How can adequate financing of the agency's programs to be assured? To what extent can the agency modify existing legal obligations?

The advantages and disadvantages of interstate compacts depend in large measure on the decisions reached on these issues in the process of negotiating the terms of the compact. One obvious advantage of compacts is that they allow for regional approaches to regional problems. Since the generation of waste oils is heaviest in conurbations like those along the eastern coast of the United States, compacts creating waste oil collection and disposal agencies to carry out the functions discussed above might be effective approaches in those areas. A disadvantage of compacts is that they normally take several years to enact: first there are elaborate preparations and negotiations of a draft compact, then as many state legislatures as there are prospective state parties must enact bills authorizing the state to participate, then the Congress, too, must approve the compact.

B. PUBLIC CORPORATIONS

States have inherent power to create corporations which may operate within their terriotries. The Congress has the power to create corporations when they are necessary proper means for carrying out any of the powers of the federal government enumerated in the Constitution, e.g., the power to regulate commerce among the states.

A public corporation is one created by and subject to the control of a legislature to carry out purposes connected with the public good in the administration of government. Public support or revenues and properties and public control are the distinguishing marks of a public corporation. The whole interests must belong to the government. Towns, cities and counties are familiar public corporations on the state level. The Federal Deposit Insurance Corporation, the U.S. Postal Service, and the Tennessee Valley Authority are well-known federal corporations. So are AMTRAK and Comsat.

Public corporations may be organized to accomplish much more limited tasks, however. In Germany, for example, the "bilge water drainage association" (Bilgenentwaesserungsverband) has more than half a dozen boats equipped to pump out Rhine-going vessels, separate the water from the oils and store the oils on board until they are pumped out to a re-refinery in Duisburg, Germany. 90% of the difference between the revenues for the products the re-refinery makes from these bilge water oils and the expenses of collection and re-refining is borne by the German states riparian to the Rhine in proportion to their population, and 10% is borne by the association of Rhine shippers, the water works on the Rhine and the government of the Netherlands (since Dutch boats are also serviced).

Public corporations could be created to carry out the collection and disposal purposes described above by either state legislatures or by the Congress. Public corporations created by Congress could be made responsible for regions crossing state boundaries. The advangtages of creating new institutions to carry out specific missions are the enthusiasm and energy which characterize the beginnings of a new project. But his enthusiasm can lead to zealousness at the beginning and after a time the institution can become more interested in building its empire or defending its prerogatives. Public corporations also tend to limit the entrance of private entrepreneurs into the activity for which the corporation is responsible. There are potential jurisdictional conflicts between federal public corporations and related state programs in the area, and vice versa.

C. GRANTS-IN-AID

Grants-in-aid from one level of government to another in support of national or state programs are quite common. Title II of the Federal Water Pollution Control Act Amendments of 1972 provides for federal grants to any state, municipality, or inter-municipal or interstate agency for the construction of publicly owned sewage treatment works, and there are state laws providing for grants to municipalities which supplement the federal share (75%). Similarly, section 105(a) (1) (A) of the Clean Air Act authorizes grants to air pollution control agencies of up to two-thirds of the cost of developing (or of up to one-half of the cost of maintaining) programs for the prevention and control of air pollution. Higher fractions of cost support are authorized for programs to control air pollution in areas containing two or more municipalities (section 105(a) (1)(B)).

These examples indicate the choices to be made in designing a project grant program: 1) what levels of government the granting government should deal with (federal, state, local, regional, interstate); 2) whether and to what extent the grants should be matching; 3) how the resources should be allocated among potential recipients; and 4) what the administrative relationships should be between grantor and grantee governments. Grants from one level of government to support programs of another level are also often conditioned on the fulfillment of specified criteria. Whether grants supporting waste oil collection and disposal programs should be conditioned upon compliance with criteria would be decided on the basis of the relationship between the governments involved and the scope of the program proposed.

Grants-in-aid can encourage grantee governments to undertake program they would not have felt able to do alone. On the other hand they can seduce a government into choosing to spend money for something for which a supplementary grant is available rather than for something more needed. Grants often have conditions which cause difficulties for the organization of state governments (e.g., the requirement that a single state agency control the program). On the other hand, these conditions often make the difference between effective and efficient use of the grant money and largesse. Indeed, it may be said that the more conditions imposed to assure the grant money is properly used, the less attractive the grant becomes. The intergovernmental relations between grantor and grantee depend almost entirely on the conditions which are specified and the means agreed upon for measuring performance under the grants. Too often the goals of giving and getting grants are lost sight of in the process of building up records of giving them out and getting them.

H.R.5902 introduced by Representative Vanik proposes a grant program of $25,000,000 a year from the federal government to assist states in fulfilling the purposes of that bill.

D. PERMIT PROGRAMS

A common way of regulating behaviour is to require those engaged in it to obtain permits and to impose conditions requiring the desired behaviour. Maryland, for example, has instituted a system of oil handlers permits which must be obtained by drivers of oil tanker trucks, owners of oil terminal facilities, and service station operators. A bill recently introduced into the Parliament in Holland would require that used oils only be collected and disposed of by licensed persons. In this way the government hopes to weed out unreliable operators. Record-keeping requirements could be imposed as conditions to permits, as could requirements for providing facilities for the collection and storage of used oils.

Permit programs could be established by state or federal legislation. Strictly federal permits are normally limited to fields pre-empted by the federal government, e.g., regulation of nuclear power plants, or placing materials in navigable waters. A recent trend, evident in the Federal Water Pollution Control Amendments of 1972, is to establish federal permit programs which can be administered by states which comply with the substantive and procedural aspects of the program. Such a system has been proposed for the regulation of hazardous wastes in S.2753 and could be applied to used oils. Since disposal of used oils is largely a problem in urban areas, however, permit programs would seem more appropriately enacted by the states affected.

Permit programs offer great flexibility, but this flexibility itself has been criticized as leaving too much discretion with functionaries often willing to compromise in order to avoid conflict. This discretion can be limited by careful drafting of the statute delegating authority to administer permits, but legislative supervision of the administration of the program is advisable. One possible means of exercising this supervision is to require the submission of periodic reports to the legislature by those responsible for administering the program.

Another difficulty with permit programs is that enforcement of their provisions is usually separated from those who prepared them. In Maryland, for example, the oil handlers permits are granted by the water quality permit division and are enforced by the general enforcement section. This presents several potential difficulties. Permits are often prepared by persons ignorant of what is necessary to have a readily enforceable document. The enforcement staff is often ignorant of the background of the provisions of the permit's conditions and may not appreciate the reasons supporting particular provisions.

As a parctical matter, a comprehensive permit program for all those who generate, collect and dispose of used oils would involve a great deal of time and personnel to administer and enforce.

E. OIL INDUSTRY COLLECTION AND DISPOSAL

Since the oil industry has the means for distributing its products, by pipeline, rail, and tanker trucks, the industry could supplement these means with equipment to collect used oil products and return them to facilities at their refineries for reprocessing.

The oil industry itself takes care of collecting and disposing of used oils in several European countries. In France the large oil firms and the re-refiners have created a private company to collect waste oils from all over the country. 50,000 tons of what is collected by this company are delivered to re-refiners, the rest is delivered to the firms' refineries where it is burned. The Belgian petroleum association, too, has created an autonomous organization to collect used oils from garages, industries and other large users. This organization is also responsible for disposing of these oils, either by incineration or re-refining, in installations approved by government health officials. In Denmark the refineries and the association of oil companies have entered into an agreement whereby the companies' contractors collect used oils form garages and deliver them to the refineries.

Each of these arrangements has been worked out in conjunction with government officials to coordinate with their programs and policies. Comparable arrangements in the United States would likewise have to take into account local circumstances and local, state and federal waste disposal programs. The feasibility of cooperative arrangements between governments and the industry need consideration, e.g., establishing municipal collection points for oil companies to collect from.

An advantage of requiring the oil industry to manage the collection and disposal of its used products is that it would enable taking advantage of an existing system of distribution. Since this system is not by any means entirely integrated, however, there would have to be adjustments made to "reverse" the flow of oil products. A disadvantage of such a requirement is that it would conflict with the present system of collecting used oils to the extent it exists, unless arrangements could be made for collaboration, perhaps on a contract basis. It would also make less used oils available to re-refiners. Oil industry representatives have raised the possibility that such a requirement would have to be accompanied by legislation providing a special exception to the antitrust laws for these activities. If so, this, and the structure of the industry itself indicate that this alternative would most appropriately be accomplished by special federal legislation. In considering this legislation Congress could determine whether or not federal pre-emption was advisable to avoid potential conflicts with subsequent state enactments.

F. POSITIVE ECONOMIC INCENTIVES TO PRIVATE ENTREPRENEURS

The catalogue of positive incentive mechanisms adopted by the federal government to encourage private enterprise to engage in desired activity includes favorable tax treatment, preferential procurement treatment, and credit subsidies. These are discussed below.

1. Federal Taxation Policies

a. The Excise Tax Reduction Act of 1965

A return to the pre-1965 lube oil excise tax structure would restore the tax differential re-refiners enjoyed in the off-highway market prior to enactment of ETRA. The excise tax would no longer be the highway user fee it is at present, but would be a device for keeping the re-refining industry alive.

Excise taxes are regressive in nature. In recent years they have been reduced or eliminated except when their receipts have been earmarked for special purposes. In these latter cases they have come to be considered user fees. Excise taxes functioning as user fees include those taxes whose receipts are funneled into the Highway Trust Fund, Land and Water Conservation Fund, and the Airport and Airways Development Fund.

Return to the pre-ETRA lube oil excise tax structure and payment of the proceeds of the tax into the general fund would thus be contrary to this policy trend. However such a return might be justified if it would be an effective means of improving economic efficiency.

Restoration of the pre-ETRA tax system would hopefully both entice new capital into the waste oil reprocessing market and provide existing re-refiners with sufficient profits to invest in new equipment and processes. However, uncertainties in the petroleum marketplace make it difficult to predict with any assurance that return to the pre-ETRA tax structure would achieve these goals. However, since the administrative adjustments required would not be of great magnitude, entailing principally a minor change in exemption procedures, and since there would be a net revenue benefit to the United States treasury, EPA is recommending reexamination of the pre-1965 lube oil excise tax structure. Such a recommendation would be consonant with the Senate's 1965 position in defense of this system. As noted previously, the Senate abandoned its opposition to ETRA's revision of the lube oil excise tax system not so much because it believed ETRA's provisions to be superior, but because it was willing to accede to them in exchange for the House's acceding to provision of the Senate version of ETRA.

b. Congressional Proposals for Lube Oil Excise Tax Reform

Several bills introduced into the 93rd Congress seek to modify the existing lubricating oil excise tax system as a means of providing assistance to the re-refining industry.

H.R. 5902, the National Oil Recycling Act, was introduced by Congressman Vanik on March 20, 1973. Identical to H.R. 5902 and with a total of 31 co-sponsors are Congressman Vanik's H.R. 9338 and H.R. 9339 (both introduced July 17, 1973), and H.R. 9860 (introduced August 2, 1973). Taxation provisions are only a small portion of the bill. They amend sections 4091 and 4093 of the Internal Revenue Code and repeal section 6424 and cross-references to it. (See The Appendix to this section for discussion of these sections.) The lubricating oil excise tax is extended to cutting and hydraulic oils and the off-highway use credit is eliminated. Recycled oils may be sold tax-free.

H.R. 10888, introduced by Congressman Fulton on October 12, 1973, and Senator Thurmond's S. 409, introduced January 16, 1973, contain provisions similar to those of Congressman Vanik's H.R. 5902.

H.R. 4421, introduced by Congressman Vigorito on February 20, 1973, revises section 4091 so as to exclude re-refined oils from the definition of the lubricating oils subject to taxation. This provision, as similar provisions in the bills described above, would make statutory the existing regulatory provisions providing for the tax-free sale of reprocessed oil or blends of reprocessed and virgin oil. H.R. 4421 also amends section 6424 to override IRS's decision in Revenue Ruling 68-108; it provides that the use of virgin oil in re-refined oil is to be considered as a use of oil otherwise than in a highway motor vehicle, thereby providing for rebate of the tax paid on the oil.

2. Federal Procurement Action

An additional means of preventing potential environmental pollution might be government procurement of re-refining products. While government lubricating oil purchases comprise but a very small percentage of the lubricating oil market, establishment of closed loop re-refining systems could provide a boost to the re-refining industry and might provide an incentive for entry into the market of new entrepreneurs with new technologies. The mechanics of developing a closed loop system for procurement of re-refined oil products have been described in the Teknekron report to EPA.

Ample precedent exists for government procurement action to assist technologies that promote environmental protection goals. Section 212 of the Clean Air Act of 1970 provides for government procurement of low-emission vehicles, even if they cost up to 200% more than higher emission vehicles for which they have been substituted. A federal Low-Emission Vehicle Certification Board certifies low-emission vehicles including among its certification criteria safety, performance, reliability, serviceability, noise level, maintenance costs, and fuel availability. For the purpose of permitting agencies to pay premium prices for low-emission vehicles, $5,000,000 is authorized for the extra payments for fiscal year 1971 and $25,000,000 for each of the two succeeding fiscal years.

Similar procurement provisions are found in section 15 of the Noise Control Act of 1972. A Low-Noise Emission Product Advisory Committee can be established by the EPA Administrator to assist him in the certification of low-noise-emission products. Low-noise emission products are to be given preference in procurement. To fund the premium price procurement policy, $1,000,000 is authorized for expenditure in fiscal year 1973 and $2,000,000 for each of the succeeding fiscal years.

Were the federal government to participate in closed loop systems, it might realize a net savings in the form of decreased lube oil purchase and waste oil disposal costs. Of course, the federal government would want to be sure that it was obtaining oil that met its chemical and performance specifications. Although chemical and engine tests would be required to assure that specifications are met, it is desirable to conduct such tests in any case so that oils can be labeled as to quality in conformance with new FTC guidelines regarding the labeling of recycled goods.

3. Credit

If a policy decision, based upon economic criteria, is made to expand the capacity of or to encourage new technological inneration within the re-refining industry then government credit subsidies might prove useful to accomplish this end. One form of credit extension could be low interest loans, by means of which existing or prospective re-refiners could obtain capital at an interest rate below prevailing market interest rates. A second form of credit extension would be a government loan guarantee, in which the federal government guarantees a private sector creditor that if a re-refiner defaults on payments of interest or principal, then the government will make good the loan.

Federal credit subsidies can be found in many sectors of the economy. In the area of commerce and economic development, one can identify small business loans, small business investment company loans and economic opportunity loans. Re-refiners or those seeking entry to the re-refining business could be encourage to seek loans through existing programs, or the federal government could establist a special loan fund to encourage re-refining. Capital for the fund could be derived from the lubricating oil excise tax.

The principal problem associated with such credit subsidies is that there is no assurance that they will be effective. One cannot predict whether private entrepreneurs will respond to the loan opportunity, and there is no way of knowing what the default rate on such loans might be.

APPENDIX: FEDERAL MANUFACTURERS' EXCISE TAXES ON LUBRICATING OILS

PROCEDURES

Provisions of the Internal Revenue Code provide for payment of an excise tax of 6 cents per gallon by manufacturers or producers of lubricating oil. No such tax is payable on imports of lubricating oil.

Lubricating oils are exempt from taxation if they are cutting oils, reclaimed oils, or oils seldom used for lubricating purposes. Also exempt from the tax are certain sales from one manufacturer to another, sales to state and local governments, sales for export, sales for use on some vessels and aircraft, and sales to certain educational organizations. Tax-exempt sales can usually be made when exemption certificates are provided to a manufacturer by a lubricating oil purchaser. These certificates may be printed by the concerned parties following a format provided by the Internal Revenue Service in its regulations.

Refunds of taxes paid may be obtained by purchasers of lubricating oils used otherwise than in a highway vehicle. Refunds may take the form either of direct payments or credits against income taxes owed.

A summary of the principal sections of the Internal Revenue Code and regulations pertaining to lubricating oils follows:

Section 4091 of the Code imposes a 6 cents per gallon tax on lubricating oils to be paid by the manufacturer or the producer.

Under section 48.4091-6 of the IRS regulations, sale of lubricating oil seldom used for lube purposes, or sale of lube oil for resale for non-lube oil purposes, may be tax-free. For a sale to be tax-free, a manufacturer must obtain an exemption certificate from the purchaser, and a purchaser purchasing lube oil for resale must obtain such a certificate from the second purchaser of the oil.

The exemption certificates which are filed are retained by the manufacturers. When sales are frequent of lube oil seldom used for lube purposes, one certificate covering an entire year's orders will be acceptable. Otherwise, one must be completed for each order. Manufacturers have a duty to ascertain the validity of a certificate.

Oils sold tax-free under the provisions of regulation 48.4091-6 do not qualify for tax refunds or credits against income tax available under sections 39(a)(3) and 6424 of the Internal Revenue Code. However, if oil on which tax has been paid is used for non-lube purposes, the ultimate purchaser may file a claim for credit under section 39(a)(3) for refund under section 6424.

Cutting oils may be sold tax-free. This may be done following any of the three procedures described in T.I.R. 784 (December 8, 1965) and Revenue Procedure 66-52, 1966-2 Cu. Bull. 1263. First, when oil is sold in containers smaller than five gallons which bear labels indicating that their contents are for use only in cutting and machining operations, when advertising for the oil indicates this, and when the oil is sold for such use or for resale for such use. Second, oil may be sold in bulk tax-free when the IRS Commissioner has determined that an oil is suitable only for cutting uses. Third, a purchaser may obtain a cutting oil exemption certificate, specifying that his oil purchase is to be used for cutting purposes. The cutting oil certification procedure is similar to the certification procedure of section 48.4091-6 for sales of lubricants seldom used for lubricating purposes.

Section 48.4093-1 of the regulations provides that sales of lubricating oil by one manufacturer to another manufacturer for resale may be on a tax-free basis, provided that both manufacturer and purchaser have registered with the District Director of Internal Revenue. For subsequent tax-collection purposes, the purchaser of oil made tax-free under the provisions of this section is considered to be the manufacturer of the oil so purchased.

Section 6424 of the Internal Revenue Code provides that the ultimate purchaser of lubricating oil (other than cutting or previously used oils) used otherwise than in a highway vehicle, may obtain a 6 cents per gallon payment from the government. Under the provisions of section 39(a)(3) of the Code, this ultimate purchaser may claim this as a credit against his income tax. Alternatively, if the amount claimed exceeds $1000 for the first, second or third quarter of the year, he may file a claim for the amount prior to the last day of the quarter following the quarter in which the claimed refund exceeds $1000.

IRS form 843 is used to make a quarterly claim. For a yearly claim, IRS form 4136 is attached to the income tax form filed by the claiment -- form 1040, 1120, 1120-S or 1065. The individual seeking a refund indicates the number of gallons of lube oil purchased, and multiplies this by 6 cents to obtain the total for the credit sought. The taxpayer must also list the general purposes for which the oil has been used. Section 6424(d)(2) of the Code provides that witnesses and books may be examined to determine the validity of credit claims.

Those exempt from income tax do not claim a credit against their income tax, but obtain direct refunds. No amount is payable under section 6424 for oils which have been used off the highway but which have been sold tax-free.

Section 4218 of the Code provides that if an individual manufacturer produces lubricating oil and uses it otherwise than in a taxable item, then he pays tax on it equivalent to the tax payable were he to sell it. However, if sale of the oil to another purchaser for a particular (e.g., non-lubricating) use would be tax-exempt, when the manufacturer uses the oil in such a non-taxable manner himself, he is not liable for tax.

Section 4221 of the Code provides that sales of lube oil are tax-exempt if the lube oil:

1. is for use by a purchaser for further manufacture, or for resale by the purchaser to a second purchaser for use by the second purchaser in manufacture;

2. is for export, or for resale by a purchaser to a second purchaser for export;

3. is for use by a purchaser as a supply for vessels or aircraft (though the definition of vessels and aircraft is restrictive);

4. is to a state or local government for its exclusive use;

5. is to a non-profit educational organization holding a Code section 501(a) exemption.

Generally speaking, exemption certificates are required for tax-exempt sales in categories 1, 3 and 4 above. For export sales, proof of export must be shown to obtain exemption. For sales to section 501(a) tax exempt educations organizations, the organizations and the manufacturers must be registered with the Internal Revenue Service.

V. FEDERAL FUNDING OPTIONS FOR WASTE OIL PROGRAMS -- SOURCES OF REVENUE

Revenue for funding collection and disposal of waste oil may be derived from existing federal or state or local tax revenue or from the collection of special disposal fees. A funding system should be easy to administer and require users of oil to pay the cost of its disposal. Among the possible funding options are the following:

A. DISBURSEMENTS FROM GENERAL REVENUES

Under this option, the federal government could devote a share of general revenues to a waste oil program. The principal argument against this particular option is that it imposes the cost of waste oil collection and disposal on all taxpayers, rather than on the users of lubricating oil. Since it is fairer to impose these costs on those who cause them and there are feasible means to do so, these means will be the focus of this discussion.

B. IMPOSE A DISPOSAL FEE AT THE POINT OF FINAL PURCHASE OR DISPOSAL

Under this option, a disposal charge would be imposed at the point of ultimate purchase or at the point of ultimate disposal. Imposing a charge at the point of ultimate disposal would tend to encourage clandestine means of disposal in order to avoid the charge and would necessitate a highly developed regulatory system in which all disposal is controlled and in which all or most oil transactions are recorded. Imposing a charge at the point of ultimate purchase might be a preferable alternative, but because so many outlets sell lubricating oils, the administrative requirements of such a system would be considerable. While on the basis of equity these options are superior to the funding of a waste oil program through general revenues, their attendant administrative problems do not recommend them.

C. DEVOTE PROCEEDS FROM THE EXISTING EXCISE TAX OR A VARIANT OF IT TO A WASTE OIL DISPOSAL FUND

It could be argued that proceeds from the existing lubricating oil excise tax or from a pre-ETRA lube oil excise tax system or some variant of it should be credited to a waste oil disposal fund instead of the Highway Trust Fund. This would convert the excise tax from a highway user fee to a lubricating oil user fee. While the fee would be assessed on the manufacturer or producer, it is assumed that the cost of the fee would be passed on to the ultimate user of the oil.

The following Table summarizes key lubricating oil excise tax data for the last five fiscal years. The data indicate that while gross receipts from the lubricating oil excise tax are now 25% higher than they were five years ago, receipts for each year have constantly represented less than 2% of the gross revenues provided the Highway Trust Fund by automotive excise taxes. Cash refunds of the lubricating oil tax have remained at a constant $2,000,000 while income tax credits granted have ranged from $15,000,000 to $19,000,000. The refunds and credits granted each year have represented from 16% to 23% of the gross lubricating oil excise tax receipts. Should it be decided that the approximately $80,000,000 in net receipts is too large a sum to devote to abating the problems associated with existing waste oil collection and disposal practices, then it might be desirable to earmark only a portion of these receipts for a waste oil disposal fund.

The appendix to the previous section outlines the procedures for administering the lubricating oil excise tax and describes the large numbers of exemptions and credits that are available under the existing lubricating oil excise tax system. Using the existing system for waste oil disposal purposes would be a simple administrative matter involving a minor bookkeeping change. However, because of the various exemptions and credits the present system provides, some generators of waste oil would bear an undue share of the waste oil disposal cost while others would not bear their share of the costs of disposal. For example, a business enterprise purchasing lubricating oil and using it in highway vehicles would pay the lubricating oil tax while a state purchasing oil for its own use in highway vehicles would be exempt from it. However, the state, like the business enterprise, would be generating waste oils having disposal costs. If some waste oil disposal program funded by the excise tax was established which provided free pick-up of waste oils, the excise taxes paid by the business enterprise would be used to provide free pick-up for the state's waste oils. In a similar vein, since cutting oils are exempt from the present lubricating oil tax, the business enterprise would also be subsidizing the collection of waste cutting oils from industrial operations of others.

One might reduce the inequities somewhat by modifying the existing system of exemptions and credits thereby providing a closer relationship between generation of waste oils and payment of disposal fees. One means of doing this would be by eliminating the distinction between on and off-highway uses and basing exemptions on whether particular uses of lubricating oils result in generation of waste oils. This would require a moderate overhaul of the existing lubricating oil excise tax system and would be achieved in large measure by a number of congressional proposals which in effect call for a return, in somewhat modified form, to the pre-ETRA excise tax system. These proposals however, do not assign the tax proceeds to a special waste oil fund, but merely extend the tax's application and eliminate the credit for off-highway use.

It does not seem that it would be especially burdensome to make administrative judgements on the "waste-potential" of lubricating oils. Revenue Ruling 70-55, I.R.B. 1970-5, 17, lists four categories of oils which are seldom used as lubricants (within the meaning of section 48.4091-6 of the IRS regulations) and which may therefore be sold tax-free. Category 1 consists of 32 "non-recovered process aids." These oils do not become part of finished products, are not reused and are lost or discarded as a function of the process. Category 2 consists of 13 surface coating oils that are applied to the surface of other substances, are not reused or recovered, but remain on the surface of the substances to which they are applied. Category 3 consists of 45 oils that become an integral part of finished products that are not lubricants and are not used for lubricating purposes. Category 4 consists of 17 oils performing physical or mechanical functions other than lubrication that are not included in any of the preceding groups.

Under a revised tax system in which taxation (i.e. assessment of a user fee) was based on waste generation, the oils in categories 2 and 3 would clearly remain tax-exempt, while administrative decisions would have to be made concerning continuation of the exemptions for oils in categories 1 and 4.

LUBRICATING OIL EXCISE TAX RECEIPTS AND REBATES AND THEIR RELATIONSHIP TO THE HIGHWAY TRUST FUND

FISCAL YEAR	(1) GROSS LUBE OIL EXCISE TAX RECEIPTS	(2) CASH REFUNDS OF LUBE OIL EXCISE TAX	(3) INCOME TAX CREDITS FOR LUBE OIL EXCISE TAX	(4) TOTAL LUBE OIL EXCISE TAX REFUNDS AND CREDITS	(5) REFUNDS & CREDITS: GROSS LUBE TAX RECIPTS (%)	(6) GROSS RECIPTS TO HTF FROM AUTOMOTIVE EXCISE TAXES	(7) GROSS LUBE TAX RECEIPTS: GROSS HTF RECEIPTS (%)
73	$103,000,000	$2,000,000	$17,000,000	$19,000,000	18	$5,695,000,000*	1.8
72	95,474,000	2,000,000	16,000,000	18,000,000	19	5,635,000,000	1.7
71	88,185,000	2,000,000	19,000,000	20,000,000**	23	5,664,000,000	1.6
70	94,521,000	2,000,000	13,000,000	15,000,000	16	5,353,627,000	1.8
69	82,842,000	2,000,000	13,000,000	15,000,000	18	4,637,176,000	1.8

* Figure for 1973 Highway Trust Fund receipts is a net sum.

** Sum represents total of original figures added and rounded to nearest million dollars.

Sources: Annual Report of Commissioner of Internal Revenue for 1972, 1971; Internal Revenue Service, "Internal Revenue Collections of Excise Taxes." Telephone conversations with personnel of Treasury Department, Public Affairs Office and IRS Excise Tax Branch. Highway Trust Fund figures for Fiscal Years 1973, 1972, and 1971 were furnished by the Highway Users Federation Public Affairs Office.

An alternative proposal would be to tax all sales of lubricating oils providing no exemptions whatsoever. This would simplify administration of the excise tax, for IRS auditors would no longer have to check exemption certificates and rebate claims. This would also mean imposing a fee on state governments to which constitutional objections would be raised. However, the courts may be willing to hold that an imposition of a user fee on a state by the federal government does not constitute federal taxation of a state. States presently pay aviation-related excise taxes into the Airport and Airway Development Fund and their obligation to make such payments has thus far been upheld in the courts. 1/

A principal objection to removing all exemptions would be that users of oil which do not create disposal problems would be paying a user fee to underwrite disposal of other oil users' waste oil. For example, certain oils (such as those used in paper processing) are consumed in use. These are presently exempt from taxation because they are lubricating oils seldom used for lubricating purposes. Under a lubricating oil disposal fee system allowing no exemptions, users of paper processing oils would begin to pay a fee which they formerly did not pay, and the proceeds would be used to dispose of waste oils from operations other than their own.

D. DISCARD THE EXISTING EXCISE TAX AND ESTABLISH A DISPOSAL FEE

Under this option, the existing excise tax system would be repealed and a disposal fee would be established. The principal difference between this proposal and some of the proposals described above is that under this option, the disposal fee would be set at a level where the proceeds from it would suffice to "solve" the waste oil collection and disposal "problem," whereas under the preceding proposals, the disposal fee would be at the level of the existing excise tax, 6 cents per gallon.

Establishment of an oil disposal fee in lieu of the existing lubricating oil excise tax system shares many of the administrative problems of some of the options previously discussed. But more importantly, it requires an estimation of an appropriate fee level. The precedent for establishing a lubricating oil disposal fee comes from Germany, but there, because of previous experience with re-refining industry subsidies, the German government had some idea when the disposal fee was initiated of what its approximate level should be. In the United States, we have no such subsidy experience behind us and no one really knows at what level a disposal fee should be set.

E. SUMMARY

A variety of options have been reviewed and none has been found to be simultaneously simple to administer and completely equitable. It would appear though that minimal administrative costs would be incurred and the greatest equity would be achieved by devoting all or part of the proceeds of a revised lubricating oil excise tax to a disposal fund while at the same time eliminating certain of the existing rebate and exemption provisions (e.g. credits and rebates for off-highway use and exemptions for sales to state and local government for their own use and sales to certain nonprofit educational organizations).

FOOTNOTE

1/ The Airport and Airway Revenue Act of 1970 is Title II of Public Law 91-258, the Airport and Airway Development Act of 1970. The Development Act establishes an airport and airway development fund, analogous to the Highway Trust Fund, whose revenues would be devoted to airport and airway development. The Airport and Airway Revenue Act amends the Internal Revenue Code so as to earmark revenue from airline transportation and fuel excise taxes for the new established trust fund. Simultaneously, the Revenue Act eliminates a wide range of excise tax exemptions. Among these are the exemptions which the federal government and state and local governments had enjoyed pursuant to sections 4292 and 4293 of the Internal Revenue Code.

The Committee on Ways and Means, in its report on the Revenue Act, stated:

> Present law provides a series of exemptions from the tax on transportation of persons by air. These include exemptions: . . . (5)for transportation furnished to the United States (at the discretion of the Secretary of the treasury) and to State and local governments; . . . .
>
> The exemptions for transportation furnished to State and local governments, the United States, and nonprofit organizations are terminated . . . . It did not seem appropriate to continue special exemptions to these governmental and educational organizations since this tax is now generally viewed as a user charge. In this situation there would appear to be no reason why these governmental and educational organizations should not pay for their share of the use of the airway facilities. (H. Rpt. 91-601 at 45-46. See also S. Rep. 91-706 at 18).

The Committee had noted earlier:

> Under this legislation a better future is promised because a trust fund will be established and there will be a direct relationship between the use of the system and the money generated to meet the needs required by the users. It

> is fitting that the primary financial burden will be assumed by the direct users. (H. Rpt. 91-601 at 3).

The state of Texas challenged the new law, alleging on constitutional grounds that it should continue to be exempt from the airport transportation excise tax. However, the federal government's right to levy this user charge on Texas was upheld by the U.S. District Court for the Western District of Texas and by the 5th Circuit Court of Appeals (State of Texas v. U.S., 73 USTC 16,085, 30 AFTR 2d 72-5930). The pertinent portions of the district court decision follow:

> The airway user charge is not a tax in the traditional sense, but instead is a charge for services rendered and represents a quid pro quo, and as such, is outside the scope of the doctrine of implied intergovernmental tax immunity. New York v. United States, 326 U.S. 572 (1946); Head Money Cases 112 U.S. 581 (1884); Packet v. Keokuk, 95 U.S. 80 (1877).
>
> Nothing in the historical basis of dual sovereignty underlying the principle of State immunity from federal taxation requires that the States continue to receive the benefit of airway facilities and services actually used by the States but furnished by the federal government without bearing their equitable share of the costs incurred in providing those particular benefits. Even employees of the federal government must pay the air transportation charge. No logical reason exists why all users of the air transportation system should not pay their fair share of such costs.

C. Need to Consider Establishing a National Program to Inspect Petroleum Product Quality

As indicated in the preceding sections, some products -- both re-refined and virgin -- do not conform to a number of accepted standards of quality and most existing state petroleum product inspection programs are able only to check randomly for compliance with a few of the less telling indices of quality.

Petroleum products, e.g. lubricating oils can be tested for performance (in laboratory engines, for example) or subjected to so-called laboratory bench tests. Performance tests are expensive, however, ($15,000 - $20,000 for a series of eight basic tests on a sample) so neither states nor most producers can affort to conduct them. Bench tests alone, however, are not a sufficient means for determining the quality of lubricating oils. The parameters they check, e.g., viscosity, are important to but inadequate for a full analysis of the quality characteristics of a sample of oil.

Currently lubricating oils are performance and bench-tested by independent laboratories. This is done to insure a credibility of results which would be absent if the oils were tested either by their manufacturers or the producers of the additives which are vital constituents. Often oils are put in cans without testing for compliance with the levels of quality stated on the labels.

Because the quality of many petroleum products is erratic, because most state inspection programs and producers of oil products cannot afford to regularly perform the tests necessary to determine quality, and in order to assure that petroleum products conform to the specifications on their labels, consideration should be given to establishing a national program for periodic and random testing of those petroleum products, e.g., lubricating oils, where deviation from standards would potentially cause serious private or public damage. Such a program could be financed from excise taxes imposed on oil products and could be conducted by the existing independent laboratories or a group of specially created public or private laboratories. It could also help reduce and spread the costs of quality control in addition to filling a national need to assure that oils meet the requisite standards of quality.

STATE WASTE OIL DISPOSAL CONTROLS

This section reports the results of an Environmental Law Institute survey of state programs that have been designed or may be used for elimination of waste oil as an environmental pollutant. The survey revealed that only three states have initiated waste oil management programs. A few additional states advised that they either are encouraging the reclaiming of waste oil or that they are studying the problem. A large number of states have developed procedures for regulating some element of the waste oil stream -- storage, transportation, or disposal on land -- but these procedures are generally applied to all hazardous or industrial wastes or to all petroleum products, and have not been designed with waste oil specifically in mind. A large number of states have also enacted highly detailed oil pollution control statutes, but all these are coastal states whose primary concern appears to be spills of oil from ships and from harbor facilities.

Many of the programs which have been specifically designed for waste oil management are of recent origin. So too are many of the regulatory mechanisms which may be directed at one element of the waste oil stream. While operating experience with them may therefore be limited, they nevertheless represent regulatory initiatives which might be copied by other states.

STATE CONCERN WITH WASTE OIL

For analytical purposes, states have been grouped into the following categories:

1. States having "waste oil management programs";
2. States expressing concern for waste oil management;
3. States having legal mechanisms which may be used to monitor or control waste oil streams;
4. States having comprehensive oil pollution control statutes which provide evidence of state concern with oil pollution but which may or may not be useful in regulating waste oil;
5. States whose statutes contain few provisions explicitly concerned with oil pollution.

STATES WITH WASTE OIL MANAGEMENT PROGRAMS

Maryland, Massachusetts and Vermont have begun planning waste oil management programs. The three states differ in the legal basis they provide for their efforts. The Maryland and Massachusetts programs have an elaborate statutory and regulatory basis. Vermont, in contrast has not elaborated an extensive set of either statutes or regulations for the control of oil pollution or waste oil, but it has begun planning a waste oil collection system. Efforts to provide for the collection and disposal of waste oil are common to the three state programs, but they differ from one another in the extent to which they monitor sources of waste oil. The states also differ in their reporting requirements. Maryland, for example, though it licenses sources of waste oil and waste oil transportation, does not provide for detailed record-keeping in its regulations. Massachusetts, in contrast, does not license service stations, but it does require waste oil haulers to maintain detailed records of their pick-ups and discharges. Vermont, as noted, has not elaborated a regulatory basis for controlling waste oil.

Maryland

Maryland has enacted laws and promulgated regulations governing a broad range of oil handling activities, including storage, transportation and disposal. Areas covered include shipping, trucking, port facilities, transfer facilities and facilities generating waste oils.

Article 96A, Sec. 26A. of the Annotated Code of Maryland permits the Department of Natural Resources to prescribe regulations for transfer, storage, separation, removal, treatment, and disposal of oil and other unctuous substances. No one engaged in any commercial or industrial operation may conduct such activities without a Department of Natural Resources permit.

Sec. 29. of state law governs oil pollution from ships. Sec. 29(a) makes it unlawful to discharge oil from ships into state waters, except in case of accident, collision, stranding, or in case of emergency imperiling life or property. Sec. 29(a-1) requires the immediate reporting of discharges by those responsible for them. Sec. 29(b) provides that discharges and their nonreporting are misdemeanors punishable by specified penalties.

Sec. 29A. gives responsibility for developing an oil spill emergency program to the Maryland Port Authority and the Department of Natural Resources.

Sec. 29AB. requires a bond of $100.00 per gross ton for all vessels entering Maryland waters to discharge bulk oil cargos. Bond is forfeited to the extent it must be used to cover clean-up costs and pay state penalties if a ship has discharged oil into state waters. Where financial responsibility has been demonstrated to the federal government, a vessel is exempt from Maryland provisions requiring posting of bond. Non-posting of a required bond is punishable by a $5,000 fine.

Sec. 29B. provides that the state may charge and collect a compensatory fee from an oil discharger to cover clean-up and environmental restoration costs.

Sec. 29F. provides that oil terminal facilities operated within the state must be licensed, and license fees are payable in proportion to the storage capacity of the licensed facility. To obtain a license, a facility operator must demonstrate capability for complying with state and federal pollution control and abatement laws.

Sec. 29G. establishes an Oil Disaster Containment, Clean-Up and Contingency Fund. Penalties and fees assessed under the above provisions are credited to the fund, and expenses entailed in state implementation of the above provisions are to be charged against it.

Water Resources Administration Regulations 08.05.04.07 et seq. govern oil pollution control. These implement the statutory requirements for oil handling permits described above.

Sec. I(c) (1). provides that to obtain permits, applicants must submit information describing comprehensive spill contingency plans.

Sec. I(E)(1). prohibits discharge of oil into state waters that will cause pollution or violation of water quality standards. Sec. I(E)(2) similarly forbids discharge of bilge or ballast water.

Sec. (G)(1) requires immediate reporting of oil discharges.

Sec. II. elaborates on the statutory vessel bonding requirements described above.

Sec. III. describes permit requirements for marine oil transfer facilities, providing an elaboration on permit application information requirements, and specifying operating procedures for oil transfer operations.

Sec. IV. reiterates the permit requirements of Section I as they apply to oil storage facilities, and provides a detailed description of material requirements for such facilities.

Sec. V. pertains to oil deliveries by truck tank. It requires oil vehicle operators to be licensed by the state, after having been trained in pollution prevention and containment operations, and it describes operating procedures and equipment requirements for oil deliveries.

Sec. VI. elaborates on requirements for oil transfer facilities.

Sec. VII. describes requirements for facilities handling used oil. Sec. VII(C) requires that waste oil shall be disposed in such a manner as to avoid water pollution. Road oiling is permitted.

Sec. VIII. elaborates on permit requirements for gas stations and vehicle maintenance shops. Oil separating systems and separate drainage must be maintained, and waste oil must be disposed of in a non-polluting way, i.e. used as a fuel, given or sold to a salvager, or used for dust abatement.

Maryland has been concerned with pollution attributable to waste oil for at least two years, and in conjunction with the United States Environmental Protection Agency has sponsored a study by Environmental Quality Systems, Inc. to produce a comprehensive waste oil management program for the state. The recently completed (November 1973) draft report suggests that the regulations described above be rewritten to include provisions for waste oil collectors' reporting to the state and maintaining detailed collection records. The report also suggests reworking the application for oil handling permits so as to more effectively meet state waste oil data needs. Also recommended are controls on out-of-state shipments of waste oils and development of a series of financial incentives for funding the proposed program. 1/

Administration of Maryland's waste oil management program began on October 20, 1972. As of December 31, 1973, 333 oil handler permits had been issued and 848 oil tanker drivers had been certified. In addition, 126 licenses for oil transfer facilities had been issued pursuant to the oil storage licensing provisions of the Annotated Code of Maryland.

No fee is attached to permits for oil handlers or certificates for tanker drivers, but statutorily established fees are collected for oil terminal facility licenses.

The regulatory program is administered by the Department of Natural Resources' Water Quality Permit Programs office. Three individuals assisted by one secretary process applications and conduct inspections prior to the issuance of permits. The budget for FY74 for this regulatory program is $200,000. Enforcement of permit and license requirements is one of the responsibilities of the twenty members of the Department of Natural Resources' enforcement division.

To date, Maryland's regulatory effort has focused on oil terminals and distributors, the major potential sources of polluting oil. 600 applications for permits are presently pending. It is estimated that 2000-3000 permits should suffice for the 4000-5000 service station operations within the state (since only one permit is required of a single party owning many stations), but the state has not yet formally notified service stations of the permit requirement. 2/

Massachusetts

Section 52 of the Massachusetts Clean Water Act provides for the licensing of waste oil haulers. Section 52A. added to the Massachusetts General Laws on December 7, 1973 requires service stations, marinas and retail outlets selling automotive lubricating oil to install waste oil retention facilities and to accept at no charge waste oil in quantities not exceeding two gallons per day from any individual showing proof of purchase from the retailer.

Control of waste oil is vested within the state Water Resources Commission and Hazardous Waste Board. In early 1973, hazardous waste regulations were adopted which explicitly include within their scope the collection and disposal of waste oil. The regulations declare that the recovery or recycling of wastes to useful products, with minimum production of by-product wastes, is the preferred method of disposal.

The regulations are intended to cover handling and disposal methods involving conveyance of hazardous wastes by truck, rail or vessel from a point of origin to an offsite disposal area. Permits for on-site accumulation of hazardous wastes by originators of such wastes (i.e. service stations, industrial companies, etc.) are not required. 3/

Regulation 1.0 states that collection and disposal of waste oil is deemed to fall within the hazardous waste regulation provisions.

Regulation 3.1 provides that collection, conveyance and disposal of hazardous wastes may only be conducted under state license.

Regulation 3.4 forbids the dumping of waste oil and other specified hazardous wastes into offshore state waters without state permission.

Regulation 3.5 requires segregation of wastes by classes and requires that they be stored and maintained in such a manner so that container ruptures will not cause or contribute to a condition in contravention of state water quality standards.

Regulation 4.0 identifies the several classes of hazardous materials, one of which is waste oil.

Regulation 5.1 declares that insofar as feasible or practical, waste oils should be reprocessed for use, or used directly in original or secondary markets where such use meets all applicable environmental standards. Alternative disposal methods such as incineration or land spreading will be permitted only if it is shown by an applicant that reprocessing or direct use is not feasible or practical and if such methods meet all applicable environmental standards. Collection of waste oil intended for disposal outside the state is prohibited unless the ultimate disposal facility is approved by the U. S. Environmental Protection Agency or the appropriate state pollution control agency.

Regulation 6.0 details licensing requirements. Section 6.2 declares that licenses must be renewed annually. Section 6.3 indicates the types of information which must be provided on the license application form, including classes and approximate quantities of wastes handled, disposal methods used or to be used, and location and plan of disposal sites. Section 6.6 provides that state representatives may enter premises at reasonable times and on reasonsble notice to inspect facilities, inventory, and records.

Section 6.9 provides that operators of vessels, trucks or other vehicles transporting hazardous wastes shall keep records of materials handled, origin, quantity and destination. Detailed logs are to be retained for one year, and monthly summaries which are not of public record are to be submitted to the state.

Regulation 7.0 provides for fines and jail terms for violators of the rules and regulations.

Massachusetts' concern with waste oil dates at least to 1968, when it funded an A. D. Little study of waste oil in Massachusetts. 4/ It has since contracted for additional studies, one of biological degradation of waste oil sludge, and one of waste oil reprocessing. 5/

The state legislature denied the Water Resources Commission's FY74 request for funds for administration of the hazardous waste management program. The request was for one full-time person for administration of the hazardous waste program and for nine additional regional engineers to conduct inspections in conjunction with this and other licensing programs. The nine additional engineers would have devoted approximately two man-years to hazardous waste-related inspections. A funding request has been made for the FY75 budget.

At present, the program is administered on a quarter-time basis by one person in the Water Resources Commission. Field inspections are conducted by fifteen regional Commission engineers who devote an estimated two-man years to hazardous waste-related inspections.

Massachusetts issues permits on an annual basis. 45 permits were issued last year and 35 were issued or renewed this year. A majority of these were to collectors but several were also issued to landfill operators. Massachusetts estimates that it has licensed approximately 90% of the major collectors operating in the state. However, it believes that perhaps 25 septic tank pumpers having incidental industrial waste hauling operations are not yet being regulated.

At one time the commonwealth had hoped to establish a storage facility and laboratory at the site of an old lubricating oil plant in Braintree, Massachusetts with state and federal funds. It had been hoped that some of the necessary funds could be derived from proceeds from state motor vehicle excise taxes, but attempts to obtain such funds were defeated in the legislature.

Senate Bill No. 1659 was introduced into the Massachusetts Senate in 1973. It was not enacted into law. 6/ It would have allocated one-fifth of one per cent of the state's motor vehicle related excise tax receipts for waste oil disposal programs. The funds would be used to pay administrative costs, including inspectors' salaries, costs of construction and operation of waste oil collection and disposal facilities, and payments for collection and transportation costs to licensed waste oil collectors.

Vermont

Vermont has begun planning a waste oil program which it hopes to have operating by Spring, 1974. The program entails the establishment of collection points around the state to which waste oil would be brought. The oil would then be trucked from these regional collection centers to larger, central collection facilities. The oil would then be shipped to a company in Palmer, Massachusetts for reprocessing into fuel oil. Vermont industries would be provided with the first purchase rights on the reprocessed oil.

The state has purchased ten 20,000 gallon collection tanks at a cost of one dollar per tank from the Mobil Oil Company. The tanks are in temporary storage at a Vermont National Guard camp. The state estimates that with transportation furnished by the Vermont National Guard, it will cost approximately $20,000 to set up the tanks around the state. It hopes to obtain an outside grant for the funding of this portion of the project. 7/

STATES EXPRESSING CONCERN FOR WASTE OIL

Four states have indicated through correspondence or reports that they have some concern for waste oil. This section briefly relates the information received to date.

Colorado

The Health Department's Division of Water Quality Control has a policy of encouraging reclamation of waste oil, and claims this is working fairly well in metropolitan areas where quantities of waste oil are sufficient to encourage economic re-refining of used oils. In rural areas, the state encourages sewage treatment plant operators to monitor possible sources of waste oil, to prevent discharges to the sewer system. Disposal of small quantities of waste oil in sanitary landfills is encouraged when there is no danger to ground water. Colorado has no specific regulations regarding disposal of residual oils or hazardous or toxic wastes, except in the case of subsurface disposal. 8/

Minnesota

Minnesota encourages recycling wherever possible. A Minneapolis re-refiner accepts waste crankcase oil. Disposal of waste oils is accomplished also by incineration, with a state-permitted incinerator functioning in the Twin Cities area. 9/

New Jersey

New Jersey is currently engaged in programs to determine efficient methods of waste oil recovery and recycling. For this purpose, it has a member on the steering committee of a waste oil study being conducted by the Council on the Environment of the City of New York.10/

Wisconsin

In 1971, petroleum inspectors of the Wisconsin Department of Revenue surveyed service stations' waste oil disposal practices. The survey did not describe the disposal of oil sold over-the-counter, nor did it describe industrial lubricating oil disposal practices. The study revealed that one-third of lubricating oil drained is re-refined to lubricating oil, one-third is reused as fuel oil, one-fifth is used on farms for lubricating barn cleaners and controlling dust and weeds, and the remainder is used for road oiling or is dumped onto the ground. Waste oil use patterns were shown to be different for high population density and low population density areas. The study did not clearly describe the percentage of the waste oil reprocessed prior to its use as fuel.11/

STATES HAVING LEGAL MECHANISMS FOR WASTE OIL MANAGEMENT

Several states have legal mechanisms which can be used to regulate one portion of the waste oil stream. These procedures include scavenger licensing systems, hazardous waste or solid waste disposal regulations, and surface storage regulations.

Scavenger Licensing Systems

Eight states, in addition to Maryland and Massachusetts, have some form of liquid waste scavenger licensing system proposed or in existence.12/ The licensing systems vary considerably in their component parts. For example, Massachusetts requires monthly and Connecticut quarterly reporting of hauling data, while Maryland has no such reporting requirements. Furthermore, while California Michigan and Massachusetts require maintenance of individual trip logs, New York and Maryland do not. Permit periods and fees also vary among the states; $25 provides a permit of indefinite length in

Oklahoma while $100 plus a per-truck fee provides a license of only one year's duration in Michigan. While many of the states require waste oil generators to consign their waste only to licensed haulers, no such requirement exists in New York. Finally, of all the states examined in detail, only California has a double-signature waste record and only Michigan requires performance bonds of waste haulers.

Michigan

In the provisions of Act 136, Public Acts of 1969, Michigan has one of the most statutorily well-defined scavenger licensing systems.

Sec. 5 requires posting of a $15,000-$30,000 surety bond with all license applications, the bond serving to indemnify the state for elimination of pollution resulting from improper disposal of industrial waste by the licensee.

Sec. 7.(1) provides for inspection of all trucks engaged in liquid waste hauling.

Sec. 8.(3) describes record keeping requirements. Records must be kept of all trips made, stating the date, source of waste, quantity, type, the location and method of disposal, and total mileage of trip. Trip records for the preceding two months are to be carried on each vehicle and trip records must be preserved for two years.

Sec. 8.(4) states that licensees are not to dispose of wastes onto the ground except at state approved sites, though waste oil may be used for dust control. No waste is to be placed in a location where it could enter any surface or ground water.

Sec. 10 provides that violations of the Act's provisions are punishable by fine, jail and license revocation.

Enactment of Act 136 was prompted by approximately a dozen serious industrial waste dumping incidents in Detroit in a short period in 1969. Most of the industrial waste dumped was oil.

Industrial waste haulers must apply for annual licenses. The annual licensing fee is $100 and their waste hauling vehicles must be licensed annually at a fee of $10 apiece.

Approximately 100 industrial waste haulers and 350 vehicles have been licensed to date. Approximately 15-20% of those licensed haul waste oil exclusively and 50-60% haul waste oil along with other industrial wastes.

To date, one hauling license has been revoked. It is expected that the bond of the licensee whose license has been revoked will be forfeited to cover the costs to the state of disposing of the 100,000 gallons of industrial waste gathered by the collector. It is anticipated that the collector's $15,000 bond will not be sufficient to cover the entire cost to the state. Otherwise, the state has not claimed any performance bonds, though it has threatened to do so "on a couple of occasions." The threat of seizure has usually been sufficient to convince waste haulers to abate their pollution.

The licensing program is the responsibility of the Oil and Hazardous Materials Control Section of the Michigan Department of Natural Resources. The industrial waste program is one of several programs administered by the section. In the program's first year, oversight was by one individual on a part-time basis. One person had a full-time responsibility during the program's second year. At the present time, oversight is divided among the nine members of the section on a geographic basis. The staff commitment is equivalent approximately to two full-time administrative positions (at $15,000 each) and one secretarial position.

Record-keeping is required on the part of both industrial waste generators and industrial waste collectors. To date, review of records has been on a "spot-check" basis, though this year each of the nine staff members will begin to tabulate the records for his district as part of a comprehensive record review program.

Road oiling is one of the permitted uses of waste oil. There have been about a half-dozen complaints received each summer of excessive road oiling (reports of oil in ditches and watercourses), but these are not regarded as significant. Plans are apparently underway to initiate new re-refining operations. There apparently is a trend away from road oiling towards other uses of waste oil. Service stations have begun to sell their waste oil.

The program is felt to be successful. Since its inception, random dumping has "totally ceased."13/

California

Division 7.5, Chapter 1 of the State Water Code governs transportation and disposal of waste. This section was added to California's statutes in 1970 and regulations implementing it were issued in March 1972.

Liquid waste haulers must register with the state Water Resources Control Board and must provide information on planned disposal sites. The state board passes the application on to regional water quality control boards, which assure that the wastes being hauled are acceptable at the disposal sites sought for use. When the regional board approves the disposal sites, the forms are returned to the state board, which then issues stickers for applicants' vehicles. Registrants are subject to conditions, directions and orders established by the state board. Haulers must dispose of liquid waste in accordance with regional water quality control board regulations and at board-approved sites.

Registration is annual. The basic registration fee is $10, and a fee is assessed for each vehicle -- $15 for the first vehicle, $10 for the second through sixth vehicles and $5 for each remaining vehicle.

Liquid waste producers may only consign waste to registered liquid waste haulers. Hauling by non-registrants does not appear to be a problem. Registered haulers will usually report activity by non-registrants, and the non-registrants, who are generally just ignorant of the registration requirement, are then provided registration information by the state.

Haulers are required to keep trip records for each load of waste hauled, starting July 1, 1973. These forms are to be retained for one year and are to be available for state inspection. They must be signed by both the generator and hauler of the waste, and when the waste is disposed, the disposal site operator must also sign the form. The state spot-checks these records.

The state could not provide exact cost figures for administration of this program. At the state level, one-quarter of a professional person-year is required to administer this program, with secretarial assistance. Because the administrative burden for this program varies among regional boards, some boards may devote more time to it than others. For example, Los Angeles has over one-half of all the registered waste haulers. There are nine regional boards, and if we assume one professional administers the program in each on a quarter-time basis, assisted by a quarter-time secretary, then the total cost to the state for the program (assuming engineers' salaries of $18,000 and secretarial salaries of $8,000) is $65,000. Those responsible for administering the program also conduct inspections incident to it.

375 companies and over 1000 vehicles have been registered to date. No permits have as yet been revoked, though the state has threatened revocation on several occasions to assure compliance with registration conditions. The state could not provide any information on the proportion of the 375 registrants hauling waste oil.

The state reports that it receives few reports of illegal dumping. Since the licensing program functions to inform individuals of legal disposal sites, it is felt that dumping has likely decreased because of wider knowledge of legal disposal site availability.

These provisions do not apply to persons hauling waste oil from service stations to industrial facilities for reuse. Liquid waste haulers are only required to obtain registration if liquid waste is hauled by a vehicle and is to be discarded.14/

New York

Section 27-0301 of New York's Environmental Conservation Law, effective January 1, 1972, provides for the registration of septic tank cleaners and industrial waste scavengers. Subpart 75-5 of the Department of Environmental Conservation's rules and regulations has been promulgated pursuant to rule-making authority granted in section 27-0301.

Permit applications must be submitted to regional departmental offices having jurisdiction over waste disposal areas to be used by applicants. Applicants must pay a $25 registration fee and must furnish information of their equipment and selected disposal sites. Each vehicle must carry a copy of the registration certificate, which must be presented to a state law enforcement officer upon demand. Registration numbers must be displayed on vehicle exteriors.

Registration duties at the nine regional offices are estimated to require one-quarter professional person-year and one-eighth secretarial person-year per office. Using a salary base of $17,000 (plus 25% benefits) for professional staff and $8,000 for secretarial assistance, the total administrative cost of the program is approximately $57,000.

The program was established principally to control septic tank pumpers. Industrial waste management was only a secondary concern. Approximately 700 permits have been issued -- 600 to septic tank pumpers and 100 to industrial waste haulers. The state has been very successful in licensing septic tank pumpers and somewhat less successful in assuring that all industrial waste haulers are licensed. The state has found it easier to identify unlicensed septic tank pumpers than to identify unlicensed industrial waste haulers. The state believes, however, that it has succeeded in licensing the larger industrial waste haulers, those accounting for perhaps 90% of all industrial waste hauled.

Registrants are required to report annually indicating the number and types of installations emptied, the volume and nature of waste products disposed of, the place and manner in which waste was disposed, and any other information the state may require. Individual trip records are not required and the state generally does not audit the annual reports to assure their veracity.

Companies hauling their own waste for off-site disposal are not required to register under New York law, and industrial waste generators are not required to give their wastes only to licensed haulers.

Enforcement of the regulations is the responsibility of the Department's approximately 500 conservation officers, who have full police powers. The enforcement process is felt to be effective. The state has obtained "substantial" fines against unregistered septic tank cleaners and it is presently in the process of rescinding two registrations because of non-compliance with registration conditions.

Governor Malcolm Wilson, in his recent "State of the State" message, made mention of waste oil management. The Department of Environmental Conservation is presently examining alternative management formulas which will be submitted for legislative consideration.15/

Connecticut

Section 25-54th of Connecticut General Statutes Annotated requires those engaged in the waste oil collection business to obtain permits from the state. Permits are issued annually and a fee of $5 is payable. The Commissioner of Environmental Protection must consult with those in the waste oil disposal business concerning the most appropriate and best method of disposal. He must also conduct a research program relating to new and improved methods of waste oil disposal.

Section 25-54th was enacted in 1969 following development of serious leaching problems from landfills where waste oils had been disposed. At the present time, no landfilling of waste oil is permitted. If waste oil generated cannot be recycled in state, then it is shipped out of state for disposal.

Permit applicants must indicate the firms from which they plan to collect wastes, indicate the process generating the waste, the anticipated volume of waste, and the anticipated disposal method. Permittees are required to report similar information to the state on a quarterly basis.

At present, 35 waste haulers are licensed. The state could not provide administrative cost figures, but it does not appear to devote much effort to this program. The state nevertheless believes that the landfill leaching problem has been reduced in scope by over 50%.

Consignment of industrial wastes to unlicensed waste haulers is forbidden. Department of Environmental Protection field personnel periodically monitor landfill records to assure that oily waste is not being landfilled. Road oiling is permitted under certain circumstances.16/

Connecticut has not devoted any special effort to waste oil disposal research and development. However, waste oils are mentioned in the General Electric study for the state that provides the basis for a statewide refuse recycling program. In its report entitled "A Proposed Plan of Solid Waste Management for Connecticut," GE comments:

> Technology exists for reprocessing many waste oil types. License collectors and force generators to use licensed collectors through permit regulations. Collectors would be required to account for all collections and disposals identifying type and location of disposal utilized.17/

In effect, GE recommends continuation of the existing program.

Oklahoma

Section 505.1(b) of the Rules and Regulations of the Oklahoma Water Resources Board provides that any person hauling industrial waste for disposal purposes must secure a permit from the Board prior to undertaking such activity. Oklahoma law also makes it illegal for an industry to consign wastes to non-permitted waste haulers.

The permit program has been functioning for eighteen months. Seven haulers have been licensed to date and two applications are pending. The state was unable to provide cost figures for administration of this very small program.

A $25 filing fee must accompany permit applications. Permits are provided for an indefinite period. Licensees are required to report monthly sources of waste, amounts of waste collected, and disposal sites.18/

Other States' Licensing Systems

Section 34A10-1.106 of South Dakota's solid waste regulations provides that hazardous and toxic wastes (those wastes that require special handling to avoid illness or injury to persons or damage to property) shall not be placed in any container for collection, transport, processing or disposal until the Department has approved the method of storage, transport, processing or disposal. Waste oil is defined as a hazardous substance in South Dakota. The state has not indicated what form regulation will take, though guidelines for the disposal of hazardous and toxic wastes are presently being developed.19/

The Indiana Stream Pollution Control Board proposes to draft a regulation in the near future which will deal with waste haulers within the state. The regulations will include a permit program.20/

The Environmental Protection Agency has been advised that Delaware has a scavenger-licensing system. Detailed information has yet to be obtained.

Surface Storage Regulations

Waste oil is stored in both tanks and open settling lagoons. Any person seeking to conduct a waste oil reprocessing operation in eleven states would have to receive state approval for its lagoon or tank operations. Among the states requiring permits for the operation of surface storage facilities are Idaho, Kansas, Maine, Massachusetts, Michigan, Minnesota, Missouri, Nebraska, New Jersey, Oklahoma, and Rhode Island.21/

Solid Waste Disposal Regulations

Twenty-four states have developed solid waste disposal laws and regulations. These are quite diverse but usually provide that liquid or hazardous wastes may not be disposed of in solid waste landfills except when special permission is granted by the state. Among the states having such requirements are Alabama, Arkansas, Connecticut, Georgia, Idaho, Illinois, Kentucky, Louisiana, Maryland, Massachusetts, Michigan, Nevada, North Carolina, North Dakota, Ohio, Oklahoma, Oregon, South Carolina, South Dakota, Tennessee, Texas, Virginia, West Virginia, and Wisconsin.22/

STATES HAVING COMPREHENSIVE OIL POLLUTION CONTROL STATUTES

Ten states (in addition to Maryland) have developed wide-ranging oil pollution control programs. All are coastal states and the prime motivation for the development of oil pollution control laws is the prevention of oil pollution from ships and port facilities. The principal components of many laws include prohibition of oil discharges on land or in water except where such discharges have been approved by the state, controls on marine port facilities, the immediate reporting of spills, and the assessment of strict liability in the event of discharges. The laws described here are not directed specifically at waste oil, but they reflect state interest in oil pollution.

Alaska

Sec. 46.03.740 is titled "oil pollution." It bans the discharge of oil into or onto lands and water of the state except in quantities allowed and at the times and locations permitted by the Department of Environmental Conservation or as permitted in the 1954 International Convention for Prevention of Pollution of the Sea by Oil.

Sec. 46.03.750 forbids the discharging of ballast water, tank cleaning waste water, or other waste containing petroleum in excess of the maximum permitted by the state water quality standards or in excess of 50 ppm of oil residue. Subject to certain exceptions, no ship may discharge a petroleum cargo to the state if it has discharged its ballast at sea.

Sec. 46.03.760 provides that violation of Secs. 740 and 750 is a misdemeanor punishable by a maximum fine of $35,000 and one year in jail. The violator is also subject to a maximum of $100,000 in civil penalties payable to the state. In addition, the individual who violates the ballast discharge provision is liable for civil damages to a maximum of $100 per gross ton, or $14,000,000 whichever is less, for his vessel. If the state proves willful negligence or misconduct, there is no ceiling on the amount of damages assessed; these damages would include costs associated with the abatement, containment or removal of a pollutant and reasonable restoration of the environment to its former condition. The damage provisions above do not affect an individual's right to recover damages under other applicable statutes or common law.

Sec. 46.03.770 provides that a vessel used in violating the above sections may be held by the state as security for damages assessed.

Sec. 46.0826(B) defines oil as being a hazardous substance.

Sec. 46.03.822 provides for strict liability for the discharge of hazardous substances, but liability is limited in instances of oil pollution to that specified in section 760 above. If an action to recover damages is brought by the state, a person is relieved from strict liability if he can prove that a hazardous substance discharge was due to an act of war or God, an intentional or negligent act of a third unrelated party, or state or federal negligence, and that in relation to these instances, he acted promptly to contain and clean up the substance.

Connecticut

Sec. 25-44bb et seq., Connecticut General Statutes Annotated, govern oil pollution control.

Sec. 25-44cc(a) gives the Commissioner of Environmental Protection responsibility for oil discharge clean-up.

Sec. 25-44cc(b) provides for annual licensing of oil terminal facilities and inspection of facility equipment. Rules and regulations for these purposes can be adopted and fees can be assessed to cover enforcement costs.

Sec. 25-54dd requires immediate reporting of polluting discharges.

Sec. 25-54ee provides for polluter reimbursement to the state of costs incurred in abating pollution or contamination resulting from petroleum or chemical liquid discharges.

Sec. 25-5ii provides for bonding of vessels carrying petroleum cargoes to assure payment to the state of all costs arising from abatement of polluting discharges from such vessels. Sec. 25-54jj provides that the state may accept other evidence of financial responsibility in lieu of such bond.

Florida

Section 403.088 states that no person may discharge waste into Florida waters which will cause their quality to drop below applicable standards. Those discharging pollutants into state waters must apply to the state for a permit. Waste discharges to inland waters are governed by this chapter.

Chapter 376 of the Florida Statutes governs oil spill prevention and pollution control. It prohibits the discharge of spillage of oil or other pollutants into coastal waters, and provides for unlimited liability for the shipper without regard to negligence. Spills in inland waters are subject to several discharge prohibitions found in Chapter 403 of Florida Law.

Sec. 376.06 provides for the licensing of oil terminal facilities. Facilities must demonstrate discharge clean-up capabilities, and licenses are renewable on a yearly basis.

Sec. 376.17 provides for development of procedures for clean-up of oil spills.

Sec. 376.09(2) requires prompt removal of pollutants by polluters, and permits the state to arrange for removal if there is a failure by a polluter to act.

Sec. 376.11 establishes a Florida coastal protection fund. It is limited to $5 million, and credited to it are license fees and penalties collected under the provisions of chapter 376. Money from the fund is to be used to carry out the purposes of chapter 376.

Sec. 376.12 allows for unlimited strict liability for all licensees of terminal facilities and shippers for damage due to oil spills.

Sec. 376.14 requires terminal facility operators and vessels docking in Florida to file performance bonds.

Sec. 376.16 levies civil penalties for violations of this chapter and rules made under it. These penalty provisions do not apply to discharges promptly reported and removed by licensees.

Maine

Title 38, subchapter 11-A, Maine Revised Statutes Annotated, is titled "Oil Discharge Prevention and Pollution Control."

Sec. 543 prohibits pollution of state waters by petroleum except when permitted by the board of Environmental Protection.

Sec. 545 provides for annual oil terminal facility licensing. Oil terminal facilities are defined to include facilities used for the purpose of transferring, processing, refining or storing petroleum products.

Sec. 548 provides for the immediate removal of polluting discharges by polluters. Payment of state clean-up costs is to be provided from the Maine Coastal Protection Fund.

Sec. 551 establishes the Maine Coastal Protection Fund. To the fund are credited license fees and penalties arising from enforcement of these oil pollution provisions. An applicant's license fee is set at a rate of one half cent for each barrel of petroleum products transferred annually. The fund is to be used to cover administrative, clean-up, and other costs associated with the oil pollution control provisions.

Sec.552 provides that licensees are strictly liable to the state for clean-up costs resulting from acts and omissions not only of their own employees, but for such actions of carriers destined for their facilities when such carriers are within state waters.

Massachusetts

The Massachusetts Clean Water Act is codified in Chapter 21 of the General Laws of the Commonwealth of Massachusetts, Sec 26 et seq.

Sec 27(10) generally provides for state clean-up of oil spills and provides for recovery of clean-up and environmental restoration costs from those responsible for discharges. Discharges must be reported immediately to the state.

Sec. 50 provides for licensing of marine oil terminals.

Sec. 50A requires oil terminal operators to have pollution control equipment and teams available for pollution prevention.

Sec. 50B provides for posting of bonds for vessels carrying petroleum cargoes and seeking to discharge cargoes to the state.

Sec. 52 provides for licensing of waste oil collectors and Sec. 58 provides for licensing of hazardous waste disposal.

Sec. 59A provides for recovery of double damages by individuals suffering damage from negligent discharges of petroleum in certain inland and tidal waters.

The Division of Water Pollution Control of the state Water Resources Commission, pursuant to these statutory provisions, has issued rules for the prevention and control of oil pollution.

North Carolina

Chapter 143, Article 53 of the General Statutes of North Carolina is titled "Oil Pollution Control."

Sec. 143-479 forbids the discharge of oil into or onto state lands or waters, or into sewer systems, regardless of whether the discharge was accidental or intentional. This prohibition does not apply to mosquito or dust abatement programs or to discharges approved by the Board of Water and Air Resources. Discharges are not unlawful when attributable to acts of God, war, or acts or omissions at the direction of a law enforcement officer or fireman.

Sec. 143-480 provides that any person having control over a discharge should undertake to remove it as soon as possible. Oil discharges must be reported to the state immediately by those responsible for them. The Water and Air Resources Board is empowered to take action to remove oil discharges.

Sec. 143-483 establishes an oil pollution protection fund, comprised of legislation appropriations and funds from fees, charges, and penalties paid under provisions of this article. Money from the fund may be used in oil spill clean-up operations. Those responsible for oil discharges are liable to the state for clean-up costs. They are also liable (Sec. 143-486) for costs incurred by the state in restoring environmental resources to their pre-discharge condition.

Civil penalties can be assessed for violation of provisions of this oil pollution article. Intentional discharges of oil are punishable by criminal penalties (Sec. 143-487).

The state may place a lien on non-bonded oil-discharging vessels, to ensure payment of clean-up and other costs (Sec. 143-488).

Section 143-489 declares that oil discharges are strictly liable for damages to public and private property resulting from oil discharges.

Sec. 143-491 provides for the registration of oil terminal facilities in the state. Certificates of operation are only to be issued to applicants who have furnished, inter alia, summaries of procedures for prevention of oil spills. Sec. 143-493 requires the Secretary of Natural and Economic Resources to report to the state legislature, by February 1, 1974, recommendations for additional legislation pertaining to oil terminal facilities.

Sec. 143-495 requires a permit from the state for refineries initiated or constructed prior to July 1, 1974. Permits will be denied if the state Board of Water and Air Resources finds the refinery will have substantial adverse effects on wildlife or fisheries, that its operation will violate air or water quality standards, that it will have substantially, adversely impact public park or recreation or forest areas, or that the installation will have substantial adverse effects on public health, safety or welfare that are not outweighed by the installations benefits.

Oregon

Sections 449.155 to 449.175 and 449.993 of the Oregon Revised Statutes pertain to discharge and spillage of oil.

Sec. 449.155 declares it unlawful for oil to enter state waters from any ship or any fixed or mobile facility onshore or offshore, regardless of whether the entry is the result of intentional or negligent conduct, or accident. Such discharge is not unlawful when it is conducted pursuant to permit, or when it is due to act of God, act of war or sabotage, United States or Oregon negligence or third party act or omission.

Sec. 449.159 provides for strict liability for oil spill damages on the part of the person having control over the oil.

Sec. 449.161 requires the person in control of oil which has entered state water to collect and remove the oil immediately.

Sec. 449.163 provides that the Department of Environmental Quality may remove the oil if the individual responsible for the entry fails to act immediately to remove it. The individual is responsible for expenses incurred by the state in so cleaning up the oil.

Sec. 449.167 provides that penalties recovered under subsection (3) of ORS S449.993 (described below) are payable to an Oil Spillage Control fund, to be administered solely for carrying out environmental rehabilitation.

Sec. 449.993(3) provides for civil penalties of up to $20,000 for each day of violation of the above described provisions in addition to any other penalties provided by law.

Sec. 47-030 of the Department of Environmental Quality regulations promulgated under the law (S47-005 through 47-030 of Oregon Administrative Rules Compilation) provides that timeliness of notice of discharge and clean-up efforts may be taken into consideration in determining the level of civil penalty incurred by dischargers.

Rhode Island

Title 46, Sec. 46-12-15 of Rhode Island General Laws gives the Health Department authority to inspect and promulgate rules and regulations governing means and methods and devices for handling petroleum employed on marine vessels engaged in handling or discharging petroleum, in order to prevent discharge of petroleum into state waters.

The state Department of Health has adopted rules and regulations governing discharges of petroleum and other substances into state waters. These were promulgated August 12, 1957.

Secs. 4-9 of the rules and regulations forbid a series of activities which may result in oil discharges. Bilge and ballast discharges are forbidden.

Shore to vessel and vessel to vessel transfers of oil are forbidden under §10 et seq. of the regulations unless specified precautionary measures against oil spillage have been taken.

Secs. 19-21 provides that operators of oil terminals should clean up spills as soon as possible, using equipment approved by the Health Department.

Virginia

Sec. 62.1-44.34:2 of the Code of Virginia provides that boat or refinery operators discharging oil into state waters are liable to the state and to private parties for the costs of clean-up or property damage incurred. State and private parties, in seeking damages do not have to prove negligence and the only defense against suit is that the discharge was caused by an act of God, an act of war, or third party action.

Sec. 62.1-195 makes it unlawful to discharge oil from a boat into navigable tidal waters of the state. Violation is a misdemeanor punishable by a fine and jail term, and a lien can be placed on the vessel involved to recover the penalty. The vessel involved will also be liable to the county or city in which oil is discharged for damages at the rate of $1 per gallon discharged, not to exceed $15,000 per violation.

Washington

Secs. 90.48.315 et seq. of the Revised Code of Washington pertain to oil pollution.

Sec. 90.48.320 makes it unlawful for oil to enter state waters from any ship or fixed or mobile on or offshore facility, regardless of whether it be intentional or by accident. This does not apply to discharges authorized by the pollution control commission, or when discharge can be shown to be the result of an act of war or sabotage, or negligence on the part of the United States or Washington.

Sec. 90.48.325 requires a person having control over discharged oil to immediately collect and remove it. S90.48.335 provides that a person failing to immediately collect discharged oil shall be liable to the state water pollution control commission for the expenses it incurs in carrying out collection and clean-up activity.

Sec. 90.48.336 provides for strict liability for oil discharges.

Sec. 90.48.343 provides that any person proposing to discharge oil into state waters must obtain prior permission from the director of the Water Pollution Control Commission. Such discharges are permitted when consonant with effluent and receiving water and treatment standards.

Sec. 90.48.350 provides for a civil penalty of up to $20,000 for illegal discharges, in addition to the other penalties described above.

Sec. 90.48.355 gives the commission right of entry and access to records for investigatory purposes.

Sec. 90.48.360 requires the immediate reporting of illegal discharges.

Sec. 90.48.390 establishes a coastal protection fund, to consist of penalties, fees and charges received pursuant to the above described provisions. Sec. 90.48.400 describes the various pollution control and research efforts to which fund resources can be put.

STATES WITH FEW STATUTORY PROVISIONS CONCERNED EXPLICITLY WITH OIL POLLUTION

The states whose laws were just outlined are those which have devoted the greatest statutory concern to oil pollution. Other states have brief statutes or regulations pertaining to oil pollution, but they are not of sufficient detail to merit extended summary. Also omitted from the preceding section were state laws governing pollution control in oil fields.

All states have general prohibitions within their statutes against the discharge of polluting wastes into state waters, and all make mention of oil in their water quality standards. Many have developed oil spill contingency plans. These actions are not of sufficient importance in the waste oil context to merit discussion.

FOOTNOTES

1/ "State of Maryland Waste Oil Recovery and Reuse Program," (Prepared for Maryland Environmental Service and the Environmental Protection Agency by Environmental Quality Systems, Inc. (November 1973) at 81.

2/ Conversation with representative of Water Resources Administration, Maryland Department of Natural Resources, January 1974.

3/ Massachusetts Water Resources Commission Division of Water Pollution Control and Hazardous Waste Board Hazardous Waste Regulations at 1 (7 pp. mimeographed, 1973).

4/ "Study of Waste Oil Disposal Practices in Massachusetts - Report to Commonwealth of Massachusetts Division of Water Pollution Control," (Arthur D. Little Co., Report # C-70698, January 1969).

5/ "Biological Degradation of Waste Oil Sludge," (Tyco Laboratories for Massachusetts Water Resources Commission, 1971); Gilford A. Chappell, "Waste Oil Reprocessing," (Esso Research and Engineering Company for Division of Water Pollution Control, Massachusetts Water Resources Commission, Project No. 72-5, January 1973).

6/ Conversation and correspondence with representative, Water Pollution Control Division, Massachusetts Water Resources Commission, September 1973; February 1974.

7/ Telephone Conversation and correspondence with represenative, Vermont Agency of Environmental Conservation, December 21, 1973.

8/ Letter to Environmental Law Institute from Colorado Department of Health, September 14, 1973.

9/ Letter to Environmental Law Institute from Minnesota Pollution Control Agency, October 19, 1973.

10/ Letter to Environmental Law Institute from New Jersey Department of Environmental Protection, November 2, 1973.

11/ Ronald O. Ostrander and Station J. Kleinert, "Drain Oil Disposal in Wisconsin," (Madison, Wisconsin Department of Natural Resources, Technical Bulletin No. 63, 1973).

12/ Several states have the authority to establish licensing systems should they so desire. For example, Rule 300.4 of the Texas Water Quality Board indicates that the Board, from time to time and as circumtances may dictate, will establish regulations to govern the collection, handling, transportation, storage, treatment and disposal of particular types of wastes.

13/ Conversation and correspondence with representative, Oil and Hazardous Materials Control Section, Michigan Department of Natural Resources, September 1973; February 1974.

14/ Conversation and correspondence with representative, California State Water Resources Control Board, September 1973; February 1974.

15/ Conversation with representative, Solid Waste Division, New York Department of Environmental Conservation, February 1974.

16/ Conversation with representative, Water Compliance and Hazardous Substances Division, Connecticut Department of Environmental Protection, February 1974.

17/ General Electric Company Corporate Research and Development, "A Proposed Plan of Solid Waste Management for Connecticut," (1973) at 65.

18/ Conversation and correspondence with representative, Oklahoma Water Resources Board, September 1973, February 1974.

19/ Letter to Environmental Law Institute from South Dakota Department of Environmental Protection, September 21, 1973.

20/ Letter to Environmental Law Institute from Indiana State Board of Health, October 16, 1973.

21/ Idaho: Rule X, Section F, Idaho Rules and Regulations for the Establishment of...Wastewater Treatment Requirements....(Adopted by Board of Environmental and Community Services, June 28, 1973);
Kansas: Sec. 65-171d, Kansas Revised Statutes;
Maine: Sec. 545, et seq, Maine Revised Statutes Annotated;
Massachusetts: Regulation 3.5 of Massachusetts Water Resources Commission Division of Water Pollution Control and Hazardous Waste Board Hazardous Waste Regulations;
Michigan: Sec. 323.1151 et seq. Michigan Administrative Code;
Minnesota: Water Pollution Control Commission Regulation WPC Y, Relating to Storage or Keeping of Oil and Other Liquid Substances. (Adopted June 26, 1964);

Missouri: Sec. 2.01 of Hazardous Materials Storage Regulations adopted by the Missouri Clean Water Commission;

Nebraska: Water Quality Standards Applicable to Nebraska Waters at 3. (Adopted by Nebraska Department of Environmental Control effective June 11, 1973);

New Jersey: The state review projects connected with the storage of petroleum and hazardous materials. Letter to Environmental Law Institute from New Jersey Department of Environmental Protection, November 2, 1973;

Oklahoma: Sec. 6 of Water Resources Board's Technical Release 100-1 (adopted July 25, 1972);

Rhode Island: Sec. 4, Rhose Island Department of Health Oil Pollution Control Rules and Regulations (Adopted August 12, 1957).

22/ Alabama: Sec. III, Alabama Rules and Regulations for Solid Waste Management (adopted by State Board of Health July 19, 1972);

Arkansas: Sec. 6(f)(cc)(8), Arkansas Solid Waste Disposal Code;

Connecticut: Title 19, Sec 19-524(n), Connecticut General Statutes Annotated (1973 supp.);

Georgia: Chapter 391-1-1, Sec 391-1-1-.04, Rules of the Deparment of Natural Resources, Environmental Protection Division (effective December 12, 1972);

Idaho: Part II, Sec. 2.19, Idaho State Board of Environmental and Community Services, Solid Waste Management Regulations and Standards (adopted June 28, 1973);

Illinois: Chapter 7, Part III, Rule 310(6), Illinois Pollution Control Board Solid Waste Rules and Regulations (effective July 27, 1973)

Kentucky: Department of Health Regulation SW 2, Part 7(8) (effective July 1, 1968);

Louisiana: Chapter X, Sec. 1052.1, 10.53.1, Louisiana State Board of Health Sanitary Code (adopted January 26, 1963);

Maryland: See description in text above.

Massachusetts: See description in text above.

Michigan: See description in text above. Also see R325.1105, Sec. 10, Michigan Administrative Code.

Nevada: Article 2, Sec. 2.6.3 Nevada Board of Health Regulations Governing Solid Waste Management (adopted January 17, 1973);

North Carolina: Sec. XI-H, North Carolina State Board of Health Rules and Regulations Providing Standards for Solid Waste Disposal (adopted March 11, 1971);

North Dakota: Sec. 5.2.3, North Dakota State Department of Health Regulation No. 86;

Ohio: Chapter HE-24, Sec. HE-24 - 09(H), Ohio Sanitary Code;

Oklahoma: Regulation 4, Sec. 4.1.15, Rules and Regulations for the Collection and Disposal of Solid Waste and Setting Standards for Sanitary Landfills (adopted by State Board of Health, June 13, 1971); Regulation 5.0, Sec. 5.2 (adopted May 1973);

Oregon: Chapter 340, Sec. 62-015, Oregon Administrative Rules Compilation;

South Carolina: PC-SW Regulation 2, Sec. VIII, Department of Health and Environmental Control, (adopted March 8, 1972);

South Dakota: Chapter 34A10-1, Sec 34A10.1.115, State Department of Environmental Protection Solid Waste Rules (proposed);

Tennessee: Regulation 6, Sec 6(c)(1)(j), Department of Public Health Regulations Governing...Solid Waste Processing and Disposal... (filed with Secretary of State January 20, 1971);

Texas: Sec E-24, Department of Health Municipal Solid Waste Rules, Standards and Regulations (effective November 5, 1970);

Virginia: Chapter XXVIII, Part VI, Rules and Regulations of the Virginia Department of Health (effective April 1, 1971);

Wisconsin: Chapter 51, Sec. 51.07, Sec. 51-10(3), Wisconsin Solid Waste Disposal Standards (adopted by the Wisconsin Natural Resources Board March 12, 1969).

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